Research and Training Opportunities in Tropical Agriculture Development (TAD) in the Caribbean Area:

Report of Program Planning Workshop, St. Petersburg, Florida December 9-10, 1974

Agricultural Research Service, USDA

in cooperation with

University of Puerto Rico ...

INDEX

AGENDA

PLANNING WORKSHOP FOR PROGRAM DEVELOPMENT FOR RESEARCH AND TRAINING IN TROPICAL AGRICULTURE IN THE FLORIDA AND ANTILLES AREA

ST. PETERSBURG HILTON HOTEL
ST. PETERSBURG, FLORIDA
DECEMBER 9-10, 1974

INTRODUCTIONS -

ANNOUNCEMENTS -

"WHY WE ARE HERE" - Dean F. Davis, Area Director
Florida-Antilles Area, USDA, ARS

KEYNOTE ADDRESS -

"The Section 406 Program for Tropical Agriculture Research and Training" - Kenneth A. Haines, Director, International Programs Division, USDA, ARS

RESPONSE -

1. "My Expectations for the Tropical Agriculture Program" Salvador E. Alemany, Dean of Studies, University of Puerto Rico

2. "Potential Contributions by the University of Florida to Tropical Agriculture" - John W. Sites, Dean for Research, Institute of Food and Agricultural Sciences, University of Florida

3. "Directions for Virgin Island Agriculture" - Fenton B. Sands, Director, V.I. Agricultural Experiment Station

4. "Five Loaves To Feed So Many" - H C Cox, Associate Deputy Administrator, Southern Region, USDA, ARS

5. Comments by Rafael Pietri-Oms, Chancellor, University of Puerto Rico

PROGRESS REPORTS - FY 1974 PROJECTS

1. "Selection, Evaluation, and Production Techniques of Plantain Varieties" .- Jose Vicente-Chandler, Research Leader, USDA, ARS, Rio Piedras, P.R.

2. "Characterization and Control of Phytopathogens Affecting Taro and Cocoyam" - Murray Gaskins, Research Leader, USDA, ARS, Gainesville, Fla.

3. "Differential Aluminum Tolerance and Phosphorous Nutrition of Sweet Potato Cultivars" - D. F. Davis, USDA, ARS, Gainesville, Fla.

4. "Development of Minor Legumes for Human and Animal Food" - George F. Freytag, Research Geneticist, USDA, ARS, Mayaguez, P.R.

PROPOSED PROGRAM - FY 1975

Continued:

1. Taro-Cocoyam Project. University of Florida

2. Plantains Project. University of Puerto Rico

3. Legume Project. ARS, Mayaguez, P.R.

New Projects:

1. S.E. Asian Fruits. University of Puerto Rico

2. Germplasm Preservation. ARS, Miami

3. Papaya Diseases. V.I. Experiment Station

4. Pigeon Peas. University of Puerto Rico

5. Tropical Fruits. University of Florida

6. Intercropping Systems. North Carolina State University

7. Nitrogen Fixation in Tropical Grasses. University of Florida

SUBCOMMITTEE WORKSHOPS AND ADMINISTRATORS' CONFERENCE

PLENARY SESSION - REPORTS BY SUBCOMMITTEES

PLANNING WORKSHOP FOR PROGRAM DEVELOPMENT FOR RESEARCH AND TRAINING IN TROPICAL AGRICULTURE IN THE FLORIDA AND ANTILLES AREA

ST. PETERSBURG HILTON HOTEL
ST. PETERSBURG, FLORIDA
DECEMBER 9-10, 1974

Participants

Administrative

University of Puerto Rico

Rafael Pietri-Oms, Chancellor
University of Puerto Rico
College Station
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040

. . .

Salvador E. Alemany
Dean of Studies
University of Puerto Rico
College Station
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
Ext. 3578
3582

. . .

Fernando del Rio
Acting Dean of Agriculture
University of Puerto Rico
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040

. . .

Mario Perez-Escolar
Acting Director
Agricultural Experiment Station
Rio Piedras, Puerto Rico 00709

Telephone: 809 767-9705

University of Florida

John W. Sites
Dean of Research, IFAS
University of Florida
Gainesville, Florida 32601

Telephone: 904 392-1784

. . .

Sherlie West
Assistant Dean for Research
IFAS, University of Florida
Gainesville, Florida 32601

Telephone: 904 392-1786

. . .

Hugh Popenoe, Director
International Programs
IFAS, University of Florida
Gainesville, Florida 32601

Telephone: 904 392-1965

. . .

Virgin Islands

Fenton B. Sands, Director
Agricultural Experiment Station
Kingshill, St. Croix
Virgin Islands 00850

Telephone: 809 778-0246

. . .

USDA, ARS

H C Cox
Associate Deputy Administrator
USDA, ARS - Southern Region
New Orleans, Louisiana 70153

Telephone: 504 589-6614

. . .

K. A. Haines, Director
International Programs Division
Hyattsville, Maryland 20782

Telephone: 301 436-8307

Dean F. Davis
Area Director
Florida-Antilles Area
USDA, ARS - Southern Region
Gainesville, Florida 32604

Telephone: 904 373-6701

. . .

Technical

University of Puerto Rico

Raul Abrams
University of Puerto Rico
Agronomy Department
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
Ext. 2494

. . .

William F. Allison
University of Puerto Rico
Dept. of Agr. Eng.
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
Ext. 2766
2770

. . .

Alejandro Ayala
University of Puerto Rico
College Station
P. O. Box 5261
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
Ext 2211

. . .

Fred H. Beinroth
University of Puerto Rico
Agronomy Department - CAAM
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
Ext. 2566

Carlos A. Fierro
University of Puerto Rico
College of Agriculture
Department of Horticulture
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040

Miguel A. Gonzalez-Roman
Agricultural Exp. Station
P. O. Box H
Rio Piedras, Puerto Rico 00928

Telephone: 809 767-9705
766-0260

Francisco Jordan
University of Puerto Rico
Horticulture Department
College of Agriculture
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040

J. Maldonado Capriles
University of Puerto Rico
Department of Biology
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040

Pedro Luis Melendez
University of Puerto Rico
College Station
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040

Jose R. Mondonedo
University of Puerto Rico
Department of Agronomy
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
833-4607

John H. Sanfiorenzo
University of Puerto Rico
Mayaguez, Puerto Rico 00708

Telephone: 809 832-4040
Ext. 2574

. . .

A. Sotomayor-Rios
Mayaguez Institute of Tropical Agriculture
Mayaguez, Puerto Rico 00708

Telephone: 809 832-2435

University of Florida

L. R. Arrington
University of Florida
Animal Science
Gainesville, Florida 32611

Telephone: 904 392-2251

. . .

R. M. Baranowski
AREC
18905 S.W. 280th St.
Homestead, Florida 33030

Telephone: 305 247-4624

. . .

R. P. Bates
University of Florida
Food Science Department
Gainesville, Florida 32611

Telephone: 904 392-1991

. . .

William G. Blue
University of Florida
Soil Science Department
106 Newell Hall
Gainesville, Florida 32611

Telephone: 904 392-1804

J. E. Butler
Dept. of Entomology and Nematology
University of Florida, IFAS
Gainesville, Florida 32611

Telephone: 904 392-1930

. . .

Frank G. Calhoun
University of Florida
Soil Science Department
2169 McCarty Hall
Gainesville, Florida 32611

Telephone: 904 392-1951

. . .

Carl W. Campbell
AREC
18905 S.W. 280th St.
Homestead, Florida 33030

Telephone: 305 247-4624

. . .

Charles A. Conover
Agric. Res. C&R
Rt. 3, Box 580
Apopka, Florida 32703

Telephone: 305 889-4161

. . .

Robert A. Conover
AREC
18905 S.W. 280th St.
Homestead, Florida 33030

Telephone: 305 247-4624

. . .

Joe Conrad
University of Florida
Animal Science, IFAS
Gainesville, Florida 32611

Telephone: 904 392-1911

. . .

Albert E. Kretschmer, Jr.
University of Florida
Ft. Pierce, Florida 33450

Telephone: 305 461-6193

G. O. Mott
University of Florida
Gainesville, Florida 32611

Telephone: 904 392-1823

. . .

Victor F. Nettles
University of Florida, IFAS
Vegetable Crops Department
Gainesville, Florida 32611

Telephone: 904 372-2136

. . .

A. J. Norden
University of Florida
Agronomy Department
Gainesville, Florida 32611

Telephone: 904 392-1811

. . .

J. R. Orsenigo
AREC - Drawer A
Belle Glade, Florida 33430

Telephone: 305 996-3062

. . .

Lawrence H. Shaw
Agricultural Eng. Dept.
IFAS
University of Florida
Gainesville, Florida 32611

Telephone: 904 392-1864

. . .

Rex L. Smith
University of Florida
Agronomy Department
2191 McCarty Hall
Gainesville, Florida 32611

Telephone: 904 392-1823

USDA, ARS

Robert E. Berry, Director
Citrus and Subtropical
Products Laboratory
600 Avenue N.W.
P. O. Box 1909
Winterhaven, Florida 33880

Telephone: 813 293-4133

. . .

Arthur K. Burditt, Jr., Research Leader
Subtropical Hort. Res. Unit
13601 Old Cutler Road
Miami, Florida 33158

Telephone: 305 238-9321

. . .

Derrell Chambers, Director
Insect Attractant, Behavior
and Basic Biology Laboratory
1700 S.W. 23rd Drive
Gainesville, Florida 32604

Telephone: 373-6701
Ext. 205

. . .

George F. Freytag
Research Plant Geneticist
Mayaguez Institute of Tropical Agriculture
P. O. Box 70
Mayaguez, Puerto Rico 00708

Telephone: 809 832-2435

. . .

Murray Gaskins, Research Leader
Plant Science Research Unit
Room 304, Newell Hall
University of Florida
Gainesville, Florida 32601

Telephone: 904 392-6180

. . .

Robert K. Knight, Jr., Research Horticulturist
Subtropical Hort. Res. Unit
13601 Old Cutler Road
Miami, Florida 33158

Telephone: 305 235-2533
0321

L. W. Larson
Assistant Area Director
USDA, ARS, Southern Region
P. O. Box 14565
Gainesville, Florida 32604

Telephone: 904 372-5251

. . .

F. J. Marousky, Research Leader
Market Quality of Ornamentals Research Unit
5007 - 60th St. E.
Bradenton, Florida 33507

Telephone: 813 755-1568

. . .

Franklin W. Martin, Research Leader
Mayaguez Institute of Tropical Agriculture
Mayaguez, Puerto Rico 00708

Telephone: 809 832-2435

. . .

Paul K. Soderholm, Research Horticulturist
Subtropical Hort. Res. Unit
13601 Old Cutler Road
Miami, Florida 33158

Telephone: 305 235-2533

. . .

Nader G. Vakili
Res. Plant Path.
Mayaguez Institute of Tropical Agriculture
Mayaguez, Puerto Rico 00708

Telephone: 809 832-2435

. . .

Jose Vicente-Chandler, Research Leader
Tropical Soil Management Practices
Puerto Rico Experiment Station
Rio Piedras, Puerto Rico 00928

Telephone: 809 767-9705

. . .

D. E. Weidhaas, Director
Insects Affecting Man Laboratory
P. O. Box 14565
Gainesville, Florida 32604

Telephone: 904 373-6701

TAD

During the meeting of the "Administrative Council" Monday afternoon in St. Petersburg, it was agreed a new name was needed for the program defined in Section 406 of the Food for Peace Legislation. A name was desired that was descriptive, short and easy to communicate. The Council decided to adopt the name "Tropical Agriculture Development;" thus, the birth of the acronym - "TAD."

"WHY WE ARE HERE"

By
Dean F. Davis
Director, Florida - Antilles Area
Agricultural Research Service, USDA

What we do in this 1-1/2 day will be a beginning, not an end. We should not think of our end product from this meeting as an end to our task. It is only a beginning.

We will need to fight our frustrations. There are so many opportunities but so little resources. For this reason alone, we need good planning.

The major purpose of this meeting is to begin the planning process.

What can we do in 1-1/2 days? I would like to suggest several objectives.

1. First, to get acquainted. Develop a comradeship.

2. To start building a team knowledgeable of the USDA program on Tropical Agriculture Research and Training.

3. To establish a background understanding of the origin and purposes of the program in tropical agriculture research and training. For this, we have speakers who have been associated with this program since its earliest origins and who have played key roles in developing the program to this point in time.

4. To begin focusing the objectives of the program.

5. To begin visualizing some possible mechanisms for implementing the program now and in the future. To become aware of the USDA interpretation of the term "Center" as a communications linkage in the network of internatical research institutes.

6. Most important, to begin identifying research and training opportunities most likely to produce benefits, and to perform this identification by working together.

7. To develop a record of our thinking which can serve as a nucleus upon which we can build. I visualize a booklet which can be retained by each of us and can be used by scientists, program planners and administrators.

8. I believe the document I visualize will become an important guideline for the future and will serve in several ways:

a. As a guideline for the Administrator of ARS and his staff for use in program planning and development, functions that are vital in the effort to reach the level of funding visualized in the enabling legislation (Section 406, PL 89-808, November, 1966).

b. As a guideline for use in communicating to the Land Grant Colleges and Universities the opportunities we believe offer the highest probability of success. It will be important that these opportunities were developed by scientists having a broad-based knowledge of the tropical countries.

c. As a guideline for future decision-makers in selecting highest-priority proposals for funding.

d. As a guideline for defining our current program objectives and for establishing future objectives.

9. Therefore, I believe that the people gathered in this room can have a significant impact on the directions this new program will take in the future. Indeed, this group can help determine whether the program has a future. We can do so by developing good ideas and by identifying research opportunities which will bring benefits to the agriculture of the developing countries and developing new approaches to training in tropical agriculture which will have lasting effects on the peoples of these countries.

10. Our task is important. Our ultimate objective of eliminating malnutrition and hunger through increased agricultural productivity, improved nutrition, greater diversity of crops, and increased labor efficiency in developing countries is one of the most noble objectives towards which man can direct his energy.

It is worth our time.

It is worth our best effort.

Let us begin.

11. Please examine your agenda. It is in three parts:

a. "Background" - Monday AM.

b. "Workgroup Activities" - Monday PM.

c. "Feedback and Reaction" - Tuesday AM.

INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

SYMBOL	NAME	CROPS	LOCATION
AVC	Asian Vegetable Center	Chinese cabbage, Mungbean, Potatoes, Soybeans, Sweet-potatoes, Tomatoes, Vegetables	Taiwan
CIAT	International Center of Tropical Agriculture	Beans, Cassava, Corn, Rice, Cattle, Livestock diseases, Swine	Colombia
CIMMYT	International Maize and Wheat Improvement Center	Barley, Corn, Triticale, Wheat	Mexico
CIP (IPC)	International Potato Center	Potatoes	Peru
IBPGR	International Board for Plant Genetic Resources		Italy
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics	Chick peas, Millet, Pearl millet, Pigeon Peas, Sorghum, Soybeans	India
IRRI	International Rice Research Institute	Rice, Multiple cropping	Phillippines
IITA	International Institute of Tropical Agriculture	Cassava, Cowpeas, Vegetables, Yams	Nigeria
ILCA	International Livestock Center for Africa	Cattle production	Ethiopia
ILRAD	International Laboratory for Research on Animal Diseases	Livestock diseases	Kenya
MITA	Mayaguez Institute of Tropical Agriculture (USDA)	Beans, Yams, Soybeans, Sorghum	Puerto Rico
WARDA	West Africa Rice Development Association	Rice	Monrovia

"THE SECTION 406 PROGRAM FOR TROPICAL AGRICULTURE RESEARCH AND TRAINING"

By
Kenneth A. Haines
Director, International Programs Division
USDA, ARS

Section 406 originated in the Agricultural Trade and Assistance Act of 1966. It has taken a long time to reach implementation. There were some references to Section 406 during the World Food Conference in Rome, Italy.

Since 1942, 80% of the food aid to needy parts of the world have come from the United States and 13% from Canada. Have the overall effects of this assistance been good? We responded to a need, but what was the effect on the countries receiving the aid? Did we cause them not to make proper investments in agriculture? Some believe that the resources of certain developing countries have been misdirected. During the World Food Conference in Rome, U.S. policy appeared to profess that the United States cannot feed the world. Instead, the United States should assist developing countries in establishing their own productive agriculture. They should become self-sufficient to the extent possible.

In 1973, total food aid amounted to $990,000,000; and in 1974, $996,000,000. Such assistance is not on the decline. In 1973, over 100,000 tons of food were shipped to Bangledesh; and in 1974, this aid amounted to 150,000 tons.

Some of the needs identified during the Rome World Food Conference were: (1) more adaptive research, and (2) more research centers. Up to now, there have been certain "sensitive crops" on which research was avoided since the crops competed with our own production on world markets. It appears now that there will be a change in U.S. policy on this sensitivity. How much of a change there will be remains to be seen.

The primary areas in which technology transfer has been effective are: (1) minerals, (2) manufacturing, and (3) resource development. Relatively little has been accomplished in agriculture.

The United States has bilateral agreements with 22 nations. These involve exchange of information for political reasons. Originally, the

U.S. Department of Agriculture has had nothing to do with these. However, now all of these nations are seeking information on agriculture. U.S.D.A. is now involved in about 15 of these bilateral agreements. However, there are no funds to support these agreements. An expression of cooperation is evident but without funds little activity is generated. The ARS program is operating at about the same level as it did in 1964, even though the amount of dollars is higher. The manpower ceiling, due to increased operating costs is at the 1969 level.

Another mechanism of cooperation is the "joint commission." These were created after the mid-east war. Recently, there have been meetings with Israel and Egypt. Egypt wants information on: (1) energy and (2) agriculture. Their interest in agriculture represents a major shift. Saudi Arabia wants the same kind of information plus information on water management. The big difference is that Saudi Arabia has money. Iran has resources and pays salaries, living costs, etc. for technology transfer. The countries that do not have money, depend on aid from the developed nations. Egypt wants a desalting plant with a capacity of about 12,000,000 gallons per day. They want to pump the water to an agricultural research farm. They are pushing this even though there is not good competency on water management. They also want to get the animals out of the field and want more milk and meat. They are interested in mechanization. Israel wants agricultural technology, and they want developmental research that can be used by industry.

The program visualized in Section 406 can have important impact on these assistance programs and on the need for technology development. Some highlights in the background of the development of Section 406 include the introduction of the concept to the Congress by the Congressional delegation from Hawaii. Finally, in 1974 the Hawaiian delegation was successful in getting the program funded. The enabling legislation (see attachment) was authored in 1966 but the first funds came in FY 1974. The U.S. Department of Agriculture did not ask for these funds until FY 1975. Good questions might be, "Why ask for funds for this program for the U.S. Department of Agriculture?" "Why not have AID do this research?" There may be no good answer for these questions. However, there were some strong feelings that the U.S. Department of Agriculture should have more of a role in assistance programs in transferring agricultural technology to developing nations.

To further assist friendly developing nations, Section 406 authorizes the Secretary of Agriculture to:

1. Enter into research contracts or research agreements with Land Grant Universities and Colleges and other institutions.

2. Conduct research on food products for dissemination to friendly nations.

3. Increase cooperation with the Peace Corps, AID, states, foundations to accomplish the overall mission of the program.

4. Expend up to $33,000,000 per year to accomplish the missions of the program.

A challenge facing all of us to prove that we can justify the program going over its current level of $500,000 per year. The initial $500,000 funding for Section 406 program was an "add on" item to the U.S.D.A. appropriation for 1974. These are U.S.D.A. funds administered by ARS in cooperation with the Cooperative States Research Service and the Economic Research Service.

The ARS coordinator for this program is Ken Haines. Mr. Haines was instructed to get the program initiated. To accomplish this, a committee was assembled representing USDA and the Land Grant Universities and Colleges. This committee met and named a smaller subcommittee to make on-site visits to potential program sites and make recommendations to the parent committee. Two "centers" were recognized: one in Hawaii and the other in Puerto Rico. The center in Hawaii would be the focal point for a program in the Pacific basin and the center in Puerto Rico would be the focal point for South and Central America and West Africa. For the purpose of this program, a "center" is defined as a "linkage in the international research network." The special subcommittee reported that facilities examined during their tour were adequate to begin the program. They recommend no construction of any new buildings. The parent committee decided what projects to fund in the first year of program operations in 1974.

The committee recommended that the program be accomplished primarily through grants to the Land Grant Colleges and Universities. This is a pattern that will stand as the program progresses. However, this does not mean that ARS will not be active in this program. ARS projects will be funded with these funds; but such projects will be limited, and will be scrutinized carefully.

How are we organized to handle this program? First, it is a USDA program and not an ARS program. It is administered by ARS for USDA. Second, recently an International Committee for Research and Education has been established representing USDA and the Land Grant Colleges and Universities. The agricultural expertise of the United States rests within the Land Grant Colleges and Universities and USDA. AID comes to these organizations requesting experts. We send out persons possessing the required expertise on assigned missions. A good question might be, "Have we sent the ones we can spare rather than the ones possessing the highest degree of expertise?" This combined committee representing the Land Grant Colleges and Universities and the USDA should have a strong voice in the future direction of assistance programs. The committee has established a subcommittee to advise on programs to be undertaken under Section 406.

This subcommittee and the administrators of the 406 program want recommendations for research and training to originate with scientists who have knowledge of tropical agriculture. Recommendations will be processed through the four ARS regions so there will be opportunity for the regions to review and have input into the program decisions.

One of the contracts funded in FY 1974 in Hawaii is a study of present knowledge of tropical agriculture. This will determine who is doing what. The information to be developed from this contract should be useful to everyone involved in the program.

One major thrust in the program will be training. How can we disseminate knowledge? One way is on-the-job training. We want to bring scientists and technicians to where the work is and where they can work with tropical materials in a tropical environment. It is hoped they will carry the research know-how back to their countries. We need some new concepts for training to accomplish this goal. The thoughts on training of the members of this workshop would be of great interest to the administrators of this program. The details for conducting the training aspects of the program have not been developed. We must develop effective means of transferring technology to the areas needing it and not just develop information without dissemination.

Another project funded in FY 1974 in Hawaii is studying the best means of transferring technology from the expert to the farmer. Information from this study should be useful to all.

We do not see the Section 406 program as "topping off" ARS or University programs. Our primary objective is to help the developing nations in the tropics and subtropics in establishing self-sufficiency in their agriculture.

SEC. 406. (a) In order to further assist friendly developing countries to become self-sufficient in food production, the Secretary of Agriculture is authorized, notwithstanding any older provision of law --

(1) To establish and administer through existing agencies of the Department of Agriculture a program of farmer-to-farmer assistance between the United States and such countries to help farmers in such countries in the practical aspects of increasing food production and distribution and improving the effectiveness of their farming operations;

(2) To enter into contracts or other cooperative agreements with, or make grants to, land-grant colleges and universities and other institutions of higher learning in the United States to recruit persons who by reason of training, education, or practical experience are knowledgeable in the practical arts and sciences of agriculture and home economics, and to train such persons in the practical techniques of transmitting to farmers in such countries improved practices in agriculture, and to participate in carrying out the program in such countries including, where desirable, additional courses for training or retraining in such countries;

(3) To consult and cooperate with private non-profit farm organizations in the exchange of farm youth and farm leaders with developing countries and in the training of farmers of such developing countries within the United States or abroad;

(4) To conduct research in tropical and subtropical agriculture for the improvement and development of tropical and subtropical food products for dissemination and cultivation in friendly countries;

(5) To coordinate the program authorized in this section with the activities of the Peace Corps, the Agency for International Development, and other agencies of the United States and to assign, upon agreement with such agencies, such persons to work with and under the administration of such agencies: Provided, That nothing in this section shall be construed to infringe upon the powers or functions of the Secretary of State;

(6) To establish by such rules and regulations as he deems necessary the conditions for eligibility and retention in and dismissal from the program established in this section, together with the terms, length and nature of service, compensation, employee status, oaths of office, and security clearances, and such persons shall be entitled to the benefits and subject to the responsibilities applicable to persons serving in the Peace Corps pursuant to the provisions of section 612, volume 75 of the Statutes at Large, as amended; and

(7) To the maximum extent practicable, to pay the costs of such program through the use of foreign currencies accruing from the sale of agricultural commodities under this Act, as provided in section 104(i).

(b) There are hereby authorized to be appropriated not to exceed $33,000,000 during any fiscal year for the purpose of carrying out the provisions of this section. (7 U.S.C. 1736.)

"MY EXPECTATION FOR THE TROPICAL AGRICULTURE PROGRAM"

By
Salvador E. Alemany
Dean of Studies, University of Puerto Rico
Mayaguez Campus

It is always stimulating and attractive to talk about expectations, because it usually implies a high degree of certainty and also involves the idea of making, preparing, envisioning, or the like. It has also been said: That there is no better idea than that whose time has arrived. Arrived it has and with such devastating evidence of the great need of increasing food production, that you can hardly get to recent news without having to read about the "World Food Crisis." There is a special section on the World Food Crisis in Time Magazine of the eleventh of November.

That same week about 1,000 delegates from 130 countries met in Rome for the World Food Conference, sponsored by the United Nations. While all this happens now, through the vision and foresight of our Congress and U.S.D.A. leadership, the Agricultural Trade and Assistance Act was enacted in 1966, authorizing the Secretary of Agriculture to conduct research and training in tropical agriculutre. Paradoxically the food needs are greatest in the Tropical Belt, where the potential is greatest, because as you well know agriculture is an energy transformation process. Approximately two thirds of the world's population live in the Tropics and if the population rates of growth continue, as they likely would, this proportion will be considerably larger in the near future.

With the food crisis as it is, the mechanism already established (Agricultural Trade and Assistance Act, Title II, Section 406) and the policy now generally accepted as expressed by Dr. George Harrar, President Emeritus of the Rockefeller Foundation: "The notion that developed agricultural nations with excess production can buffer the hungry and increasingly populous nations through donations of food grains on an ever increasing scale has finite limitations."

In view of the problem considerable effort is needed now in developing a major thrust in tropical agricultural research and training. At this time it is appropriate to mention the basic criteria as suggested for this endeavor by our study team in Hawaii:

"That guidelines established and programs implemented meet the following important criteria in achieving the goal of improving quantity and quality of food production as well as upgrading professional competence in tropical and subtropical agriculture in the United States and the community of nations."

a. Effective research and training undertakings require stability of funding for extensive periods,

b. The work is interdisciplinary and international in nature and outlook,

c. Programs must be innovative and flexible, yet not lack continuity,

d. New policy mechanisms may be required which encourage international and institutional cooperation, and

e. Complementarity with ongoing work by other groups interested in international agricultural development be maximized.

From the very beginning I have envisioned the Tropical Agriculture Research and Training Program as one administered by the Agricultural Research Service developed through two Centers or Institutes in Hawaii and Puerto Rico. It is visualized that the Institute or Centers serve as "focal points" for enabling the program. From the very beginning I have also made emphasis on what I refer to as unified approach. This is to exclude no one interested with the proper capabilities. The U.S.D.A. has developed the especially useful memoranda of understanding and can boast of an unequalled partnership with Land Grant Institutions in agricultural research. It seems to me that in order to achieve the purposes set forth in tropical agricultural research and training program the concept of partnership has to be expanded into that of consortium or multilateral cooperation.

If the funds anticipated for tropical agricultural research and training are to make an impact, new ways of thinking will be necessary in view of recent developments. Traditional approaches are likely to result in dribbles of funds for minor purposes or to satisfy interest groups. Before long term commitments are made, a thorough understanding of the state of agricultural research in the tropics is desirable.

It is a great mistake to think of the tropics as neglected, ripe for exploiting, easy to develop. In all areas of the tropics considerable serious scientific effort has already been made, often productively. Although the results are often superficial, a considerable body of well-known facts has been established and techniques have often been polished to a fine degree. Without relating a new program to the known and established, nothing worthwhile is likely to be accomplished. However, the great potential is there.

In thinking about appropriate problems for tropical agricultural research, we should be well aware of the efforts of the Consortium of International Research Centers which through its annual meetings permits a global approach to agricultural research. The centers are organized around specific crops and teams of specialists have been developed to deal with the crops in question. Great emphasis is placed on training and outreach.

In choosing crops for study emphasis has been placed on the principal food crops.

The consortium of International Agricultural Research Centers has rather carefully allocated the principal crops, including livestock, to certain well-financed centers either established or under way. It would be a great mistake for an ARS financed program to compete with these centers. However, in many cases a complementary program would be appropriate. I should probably say more than justified and completely necessary if we are to face the challenge ahead.

The main crops of the tropics have been assigned as follows:

Crop or Animal	Center	Site
Barley	CIMMYT	Mexico
Beans	CIAT	Colombia
Cassava	CIAT? IITA	Colombia, Nigeria
Chick peas	ICRISAT	India
Chinese cabbage	AVRDC	Taiwan
Corn	CIMMYT, CIAT	Mexico, Colombia
Cowpeas	IITA	Nigeria
Millet	ICRISAT	India
Mungbean	AVRDC	Taiwan
Pearl millet	ICRISAT	India
Pigeon peas	ICRISAT	India
Potatoes	IPC, AVRDC	Peru, Taiwan
Rice	IRRI, CIAT	Philippines, Colombia
Sorghum	ICRISAT	India
Soybean	ICRISAT, AVRDC	India, Taiwan
Sweet potato	AVRDC	Taiwan
Tomato	AVRDC	Taiwan
Triticale	CIMMYT	Mexico
Vegetables	IITA, AVC	Nigeria, Taiwan
Wheat	CIMMYT	Mexico
Yams(African type)	IITA	Nigeria
Cattle	CIAT	Colombia
Livestock diseases	ILRAD, CIAT	Kenya, Colombia
Swine	CIAT	Colombia
Multiple cropping	IRRI	Philippines

It would be unadvisable to begin a program with any of these crops without establishing liaison with the institutions involved.

There are certain important crops that are not covered by the consortium of International Agricultural Research Centers. These are some examples:

Yams (Asian types)	Federal Experiment Station, U.P.R.
Aroids (including cocoyams)	University of Florida, Univ. of Hawaii, University of Puerto Rico
Plantains	A.R.S. & University of Puerto Rico,
Pigeon peas	U.P.R.

It appears to me that the role of any new effort should be broad and coordinative. The kinds of jobs to be done should mainly serve the tropics as a whole even though in some instances you may need specific work for a given region. At the same time that work is developed on disciplines of most importance to the Tropics, work may be also performed on a crop basis to develop the technological packages necessary for efficient production.

On a given case the appropriate thing to do is to establish in this Hemisphere a Sub-Center for a given crop assigned to an International Center.

In mentioning the Program Thrusts, I have to be consistent with the report of the Study Team, but some changes have been made:

1. Germplasm and quarantine - Agricultural development is frequently hindered by the lack of suitable plant material. This is often a local problem due to the poor distribution of seed stock of propagation materials. A system of collection, evaluation, and distribution is urgently needed to make seed available to the tropics. But the success of such distribution depends on adequate protection against the possibility of spread of diseases and insects. A germplasm bank system, therefore, needs to be accompanied with an adequate system of quarantine.

2. Information Retrieval - One of the first order of priorities in establishing tropical and subtropical research and training activities is to know what research information is available and what research is currently underway. Work assigned to the Hawaii Agricultural Experiment Station is an important part of what has to be done. Over the long run a complete system needs to be developed.

3. Protein needs (quality and quantity). The great masses of hungry people are concentrated in the developing countries of the tropical world, where two-thirds of the world's population is found. By the year 2,000, the proportion of the population in the tropics will be greater. It is urgent to bridge this protein gap. This can best be approached by developing the production of edible legumes, by using ruminants to convert forages into quality foods for human consumption, and by developing fisheries and aquaculture.

   There are hundreds of thousands of acres in humid, steep hills and mountains that are not adapted to mechanized farming, but are suitable for grassland farming. A complementary area of research on protein production should be aquaculture. Fish are the most efficient converters of feed into high protein food with one-to-one conversions not infrequent. Results attained in cereal production demonstrated by the "green revolution" make progress through research in food legumes a definite possibility. Multiple cropping of

legumes in the tropics provides great possibilities of increasing production of high quality protein.

It seems to me that it is more meaningful to talk about:

a. Edible Legumes

b. Animal-Forage Production

c. Aquaculture and Fisheries

4. Plant Pest Control - The massive use of pesticides in the major crops of the world requires a concerted attack on problems of pest management. The research in the United States needs to be coordinated with those in other tropical areas to broaden the ecological base for observation and research. The recently completed world-wide survey of pest management problems sponsored by AID provides an excellent base from which to design the research approach.

5. Maximum Cropping - Multiple cropping and intercropping are highly desirable in order to maximize yields. Research along these lines with various food crops under different ecological conditions is of the highest importance.

6. Horticultural Crops - Research on horticultural crops in the tropics has lagged far behind research in the temperate zone. Such crops are urgently needed to provide the minerals, vitamins, and other nutrients essential to a healthful diet. Diets for many people in the tropics consist largely of grain crops such as sorghum, corn, millet, rice, or root crops such as cassava, yams, or sweet potatoes.

These diets usually lack sufficient minerals and vitamins that could be supplied by horticultural crops. Research on other crops such as plantains, papayas, mangoes, avocados, pigeon peas, etc., has lagged and is urgently needed. I find this area too broad. It seems to me more appropriate to break it down into:

a. Root and Tuber Crops

b. Tropical Fruits

c. Vegetables

7. Tropical Soils - AID has supported a five university consortium approach to tropical soils study. Several major problems requiring more concerted research are now emerging from that effort. One, for example, is the development of a new taxonomic base that reflects fertility needs and response. Sufficient data are now available to suggest that such research is basic to further coordinated attack on tropical soil fertility problems.

8. Processing and Preservation - The majority of tropical foods spoil quickly due to insect pests or fungal and bacterial diseases. Availability of foods can be improved through appropriate treatments to maintain the quality of the food in its initial form (preservation) or to change its nature to a new but acceptable, durable form (processing). Treatments may include drying, cooking, canning, freezing, or a combination. For developing countries, low-cost processing and techniques at the home level are specially necessary.

9. Communication and Cultural Change Forces - The dissemination of information and knowledge in forms that can best be understood and used by action agents in a society are catalytic to development. The "package of technology" concept for improving production and distribution of tropical and subtropical agricultural commodities has been advanced as a desirable method to stimulate positive change. How to best communicate the "Package" to potential users, how to overcome barriers to understanding and adoption, and to resolve other communication problems require study and evaluation. Institutions should be dynamic and adaptive to new needs and challenges; efficient communications between institutions and the people who comprise them are essential to understanding and therefore, to orderly cultural change.

10. Animal Pest and Disease Control - Important limiting factors to efficient animal production in the tropics and subtropics are pests and diseases. External and internal parasites either within themselves or as vectors of diseases are major deterrents. Both management practices and control measures need to be studied. Animal diseases are prevalent in the tropics and their control or eradication can greatly increase animal production and provide an avenue of foreign exchange.

11. Food Delivery Systems - The link between production and final consumption is the food delivery system. The benefits of efficient resource combination in food production activities can be lost if the food delivery systems are not operating at optimum efficiency. The detrimental effects to society are several: Consumers are either denied ample quantities of essential, nutritious foods, or they are only available at higher prices requiring a larger portion of family income; scarce resources are wasted at a cost to the whole society; and it is more difficult for all segments of the society to achieve desirable higher levels of living. Food delivery systems must be modified or developed which improve the linkage between primary production and ultimate consumption.

12. Mechanization - Mechanization includes the total concept of farm mechanization as it relates to quality and quantity of

food production. This includes development of farm equipment, from simple hand tools to more complex machinery which can be built, maintained, and used by farmers in the tropical and subtropical developing countries.

13. Nutrition and Acceptance - Tropical diets are often adequate in quantity but inadequate in quality. Particularly needed in most cases are better sources of protein or sources of specific amino acids (lysine and methionine). A further complication in compounding diets is that regional prejudices frequently block the use of available nutritious foods. More thorough studies are needed to cope with the nutritional properties and acceptance of tropical foods.

14. Water Use and Irrigation - Water is sine qua non in agricultural production and over the long run is going to be more of a limiting factor than land. It is important to find more efficient uses for water for agricultural purposes, since competing uses for this resource are going to have considerable increases in demand for the future with a high ability to pay.

15. Training - It is hard to conceive a research program without its training component. The following types of training should be considered:

    a. Graduate training geared to serve students with special interest in tropical agriculture;

    b. Work-training experience under the supervision and guidance of the various scientists working for the Program in Tropical Agriculture,

    c. Training of participants sponsored by the various foundations and international agencies,

    d. Planning, developing arranging for short courses, seminars, and workshops,

    e. Developing an exchange one year and or one semester program for scientists and professors in areas of special interests,

    f. Preparing and distributing bulletins and training material at different levels for scientists and farmers interested in research results.

Final Comment: Friends, the future is now. We shall work together with togetherness in providing our thinking, our hearts and our enthusiasm in making the Tropical Agriculture Research and Training Program a reality, not tomorrow, tomorrow may be too late.

"POTENTIAL CONTRIBUTIONS BY THE UNIVERSITY OF FLORIDA TO TROPICAL AGRICULTURE"

By
John W. Sites
Dean for Research
Institute of Food and Agricultural Sciences
University of Florida

On behalf of the University of Florida, Institute of Food and Agricultural Sciences, it is a pleasure to welcome our visitors to the state of Florida this morning and to this planning conference on tropical agricultural for Florida and the Antilles. The reasons for the conference were discussed with you in a letter of invitation to the conference, as well as the authority under which the conference is being held. In general, the objective of the conference is to think of how we may provide help to those countries in the Florida and Antilles area in such a way that they will adopt practices and technologies from our research which will help them in the production of food. From a geographical view, the areas we need to concern ourselves with primarily are Puerto Rico, the Virgin Islands, Florida, Jamaica, the Dominican Republic, the Bahamas, the lesser Antilles, Haiti, Cuba, Mexico, Guatamala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, and Trinidad. The philosophical concepts of this conference seem to me to be rather straightforward and in themselves not too complicated. The philosophy was well expressed by the U.S. Aid Administrator Daniel Parker recently at the meeting of the Land Grant College Association in Washington when he said, "our programs must be designed to help these countries help themselves."

Training

In reading Public Law 480, Section 406, it is obvious that training and research are the two major constituents of this program. One of the major roles of the University of Florida would involve training through two different functions. The first, and most important, would be training through direct participation in the active research projects being conducted here within the state, in Puerto Rico or in the Virgin Islands depending on the nature of the problems, where the facilities are located, and where the expertise exists. Such training may be made possible through the University of Florida at Gainesville or through the agricultural research and education centers scattered throughout the state which are serving specific crops and commodities. How might such a program work? Conceptually we will scale down and adapt our information and technology for application to small farm units. This is especially important in the area of mechanization and in small animal production. Both of these areas are being considered for new program

thrusts. Presently much of the technology which we are developing is oriented toward large farms and highly mechanized agriculture. This is not a practical approach for many of the developing countries. Mechanization especially would need to be adapted to the small farm and the small farmer conditions. The same general philosophy applies to small animal production. We are presently engaged in developing swine production technology for the small farmer in North Flori[illegible] looking at methods to produce and fatten hogs [illegible] capital outlay. We are trying to utilize materials normally pres[illegible] on the farm in the development of facilities for swine production [illegible] a small scale. Generally speaking, the conditions, customs, and [illegible] of the people in a given locality have to be the basis [illegible] recognized and then try to build and improve on that, improvising advancing one step at a time, so to speak.

Training, by working side by side on our research projects, is an [illegible]portant and effective way of learning because improved concepts an[illegible] technology will be accepted and put into practice better and quick[illegible] [illegible] to their own people. We invite them to work with our professionals they can in turn teach their people.

Research

As will have been noted from the information previously given [illegible] have selected five areas for new thrust consideration for 1975-76. These are:

1. Grasses and forages
2. Mechanization
3. Small animals
4. Ornamentals
5. Conversion of tropical crops to processed food prod[illegible]s

I would like to explore very briefly these five areas with you and outline possible contributions of the University of Florida

The recent breakthroughs in knowledge about the conversion of atmospheric nitrogen to metabolized nitrogen by grasses is tremendously important. Previously this symbiotic relationship of bacteria and plant has existed almost exclusively with legumes. Now work undertaken in Brazil has now shown that some tropical grasses also can perform this function. Nitrogen is now quite expensive and because of the natural gas shortage this can be a tremendously important discovery. We are going to work on this problem. You can join us and we can learn together how grasses can be induced to assimilate atmospheric nitrogen which can then be converted to plant and animal proteins.

While discussing grasses and forages, let's look also at legumes for use in tropical grass pastures. A careful survey of the native legumes in the tropics needs to be made. There can be no question of the need for legumes which will withstand grazing conditions when mixed with grasses and provide nitrogen as a necessary nutrient constituent of the beef cattle program for the tropics. We have two plant breeding programs within the state trying to satisfy this need and would be glad to work with anyone interested in cooperative work in this area. In addition, we are also interested in the development of "minor legumes" for human as well as animal food.

We have a large beef research program at the University of Florida. Forage crop management is a major adjunct to this program. Variability between genotypes is an important factor in pasture and forage management, especially their reaction to the pressure from the grazing animal. Fertilization and pest management are additional factors where differences between genotypes must be learned and evaluated. These programs offer a wide opportunity for both research and training to those interested in learning animal production technology which may be adapted to the tropics.

I have talked some on mechanization and perhaps do not need to dwell further on this except to indicate that we need to work on critical small farm problems first and these need to be defined. The field is almost limitless and very selective consideration should be given. Obviously we can't do everything, nor should we. For where there is enough demand, industry will provide pretty well for the development of farm equipment. Obviously, there are certain economics of scale which one must consider in mechanization and it will behoove us to spend our time in those areas where large industrial development of mechanization is not likely to take place.

One of the thrust areas for this year concerns small animal production for the tropics and certainly this offers a challenge to all who may be interested. The constraint of "small animals" about limits consideration to goats, swine, rabbits, and poultry. However, all of these are adaptable to small scale operations, however grain and forage requirements must be a consideration. We at the University of Florida have active research programs in each of these areas except goats and would be more than willing to work either from a research or training aspect as related to any of these animal production concepts.

Ornamental horticulture is the fastest growing industry today in the state of Florida. The tropics are especially adapted to forage plant production and to exploration for new and unique types. We have active programs in ornamentals at the University of Florida at Gainesville, at Homestead where emphasis is placed on subtropical crops, at Bradenton where our research deals mostly with commercial flower production, at Sanford where our research is concerned largely with caladium production on muck soils and at Apopka where our research is specifically oriented to production and marketing of foliage plants.

I have spent much of my time on areas for new program thrusts for these are the areas where your committees will be developing proposals. What has been said with regard to training and active research programs in these areas applies equally well to those programs which are presently in operation. I refer to (a) germplasm preparation, (b) development of minor horticultural crops, (c) development of minor legumes for human and animal food, (d) pest management, and (e) soils, fertilization and management. In all of these areas we have native counterparts and would welcome working with people from the tropics for either short or long term periods, depending upon the nature of the problems involved.

These are the ways in which I would visualize the University of Florida can help:

1. Directly working and learning together on research programs and projects.

2. Bringing the experience of our "International Program" personnel gained from working in the tropics to help through teaching and research activities on important tropical agriculture problems.

3. Training at the undergraduate and graduate levels through participation in tropical curriculum.

4. Collectively trying to learn how to motivate people to accept and use new ideas. (All of these concepts involve cooperation and they will only work when all parties participate and share.)

General Comments

New innovations in motivation to use new technology are needed. This is a research problem and research is needed on it. This is not a part of the new thrust programs but this does not diminish its importance. ARS may have trouble with this but certainly those of us at the Universities of Florida and Puerto Rico could and should be doing something on this subject.

The University of Florida offers a curriculum in tropical agriculture. This is not unique in land grant institutions, but the important feature is that it is already available at the University of Florida and can be a component of this cooperative federal-state program in helping to develop agriculture in the tropics. Few things are more basic to the success of this program than the development of a broad base of well trained people at the undergraduate level.

These are some of the ways in which I feel the University of Florida can contribute in research, training and extension in helping to develop tropical agriculture in the Caribbean. Let us all join hands so that collectively we may train people and develop techniques which will result in improved tropical agricultural production in this tremendously important area of the world around the Caribbean Sea.

"FIVE LOAVES TO FEED SO MANY"

By
H C Cox
Associate Deputy Administrator
Southern Region, ARS, USDA

Mr. Davis asked that I provide you with the ARS Southern Region's views regarding research in tropical agriculture. While considering the subject, I could not help but think about the amount of funds ($500,000) appropriated for the task in fiscal year 1974 and again, hopefully, this fiscal year -- 1975. As indicated in the letter inviting you to participate in this meeting today, focal points for research and training in the tropical agriculture program are centered in Hawaii for the Pacific Basin and in Puerto Rico for the Caribbean, which is considered to include tropical agriculture problems in the Antilles, Central and South America, and West Africa. If my references are correct, more than 250 million people live in the so-called Caribbean Area. I did not obtain an estimate, but I feel sure that an equal or greater number live in the Pacific Basin. Therefore, the contrast between the magnitude of the problem and the meagerness of our resources is striking.

In making this comparison, I was reminded of St. Matthew's account of Jesus feeding the multitude (5,000 men besides women and children) with 5 loaves of bread and 2 fish. "And they all ate and were satisfied. And they took up 12 baskets full of the broken pieces left over."

Lest we become discouraged when considering the magnitude of the problem in relation to the modesty of our resources, I think we can find a significant message in the feeding of the multitude with 5 loaves. The first point that we might make is simply that tremendous accomplishment can be made with modest investments in research. I am sure each of you can cite a number of examples.

Let's think back for a few moments about some of the factors that have contributed to our being here today. For various reasons, the developing countries have been typically unable to bring together the necessary critical mass of scientific talent to develop new technology for agricultural production through research. And yet, there is ample evidence that scientific research has been a major factor in the economic growth of more modernized societies. As a result, several national and international organizations have tried to help the developing countries fill their research void. This has been particularly true in the case of agricultural research. For many years, most people believed that we simply had to transfer scientific knowledge and expertise from the more developed areas of the world to the lesser developed areas. We assumed

that profitable, appropriate and adapted technology was available and could be readily transferred. We have now learned that this is not an entirely valid assumption. While some technology can be transferred, most of the application and much of the technology itself must be developed under the environmental and cultural conditions where that technology will be used.

Example in a microcosm -- corn planter; Iowa vs Homestead: Adapt to local conditions.

Sometimes the situation simply involves conducting research with locally available materials. I am reminded of a visit that I had several years ago with an entomologist in India who was trying to find ways to reduce the devastating losses that farmers in that country suffer due to insects in stored grain. I have forgotten the details of the construction, but he had developed earthen grain bins in which was sandwiched a polyethylene liner. Not only were insects unable to penetrate the bins, but their construction served to insulate them from extremes in weather conditions while absorbing moisture produced in the bin as a result of respiration by the grain. I suspect that an entomologist from one of the more industrialized countries would recommend more elaborate hard-surfaced bins, possibly constructed from metal, improved sanitation procedures, and the use of some sort of chemical protectant such as an insecticide.

The problems associated with trying to directly transfer technology led to the development of alternative strategies for assisting the developing countries. One of the more successful has been the development of international agricultural research and training centers. The philosophy behind this approach, of course, is the assemblage of critical masses of scientific talent in a few centers where a multidisciplinary approach may be used to solve the most critical technological problems. In thinking about our own approach to research and training in tropical agriculture, we need to remember that the international centers were not designed to supplant country efforts but were developed to complement and stimulate national research programs. I am talking about the International Rice Research Institute (IRRI) in the Philippines; the International Maize and Wheat Improvement Center (CIMMYT) in Mexico; the International Center of Tropical Agriculture (CIAT) in Colombia which is concerned with cassava, beans, beef, swine and cropping systems; the International Institute of Tropical Agriculture (IITA) in Nigeria which works on corn and rice for Africa, cow peas, pigeon peas, roots and tubers and other crops and cropping systems for the humid tropics; The International Potato Center (CIP) in Peru; The International Crops Research Institute for Semiarid Tropics (ICRISAT) which is now being established in India; The Asian Vegetable Research and Development Center (AVRDC) in Taiwan; The International Laboratory for Research on Animal Diseases (ILRAD) now being established in Kenya; and the International Livestock Center for Africa (ILCA) now being organized in Ethiopia. I specifically mention these international centers for two reasons: (1) Their organizers learned the fallibility of trying

to directly transfer technology -- a lesson we need to keep in mind, and (2) Our own need to work in cooperation, not competition, with these centers.

Remembering the failures associated with attempting to directly transfer technology, we believe that the Section 406 Tropical Agriculture Research and Training Program should be based on U. S. soil although the activities should complement research in foreign national institutions as well as the international research centers. Our belief that the program should be based on U. S. soil is pragmatic rather than chauvinistic. Simply stated, there is far less probability of the program being interrupted by adverse local political conditions than there is if the program is based in a foreign country.

Most of the international centers concentrate their research on the basic food sources -- rice, wheat, corn, sorghum, millets, the various food legumes, potatoes, cassava, yams, sweet potatoes, beef, and swine. In meeting as a task force, you have an important and critical assignment. Not only must you take care that our efforts do not conflict with our duplicate research underway, you must define and analyze problems, explore opportunities, and evaluate alternatives before coming up with recommendations for immediate and long range research and training programs. In other words, considering the limitations of our resources, the decisions you make will determine the extent to which our "five loaves" will feed the multitude.

Now, let's look ahead to the time where goals have been determined, objectives set, and research under way. Considering the complexity of the problems that must be solved, we believe that the multidisciplinary approach to research must be used or progress will be slow in coming. There was a time when plant breeders, pathologists and entomologists, for example, could pursue their own goals, but we have since learned that alteration of one component of a crop system often impinges adversely on other components in the system. Hence, the rapidly growing willingness of scientists to work together, sharing information and complementing expertise. We are extremely pleased to see the multidisciplinary approach being used in the planning session here today.

I firmly believe that involvement in research in tropical agriculture requires a new commitment to research, to problem solving, and to mission. Perhaps it would be better to say it requires a recommitment to the principles of research. It definitely means less concern for what many scientists have come to think of as the end product -- publication of a paper in a well known journal. This responsibility to our peers cannot be overlooked, but we must keep our priorities in order. First and foremost is the development of new plant varieties, improved disease and insect control measures, better fertilizer usage, improved soil management practices, and all the other components of a more productive and profitable agricultural technology.

Lastly, we must constantly examine progress and consider priorities, phasing out successful projects when complete as well as dropping unproductive projects. Our decision-making mechanism must be carefully developed in order to insure that we have a dynamic system for evaluating progress and re-examining priorities. Sensitive Area: We hate to see our "children" criticized or leave home. We cannot afford the luxury of spending a lifetime on one breakthrough or making a career out of one finding. We must move on to new problems.

We in the Southern Region feel strongly that we have only reached the threshold. We need far more research in tropical agriculture than we can possibly accomplish with the limited funds currently in hand. However, what we do with those funds may, in large measure, determine our ability to secure far more support for the program. You have a tremendous responsibiliby but an almost unlimited opportunity.

WORKGROUP ON GERMPLASM PRESERVATION

Carlos Fierro
Rex Smith
Frank W. Martin, Reporter

TITLE: Establishment of a tropical crops germplasm service.

PROBLEM SITUATION: The vast germplasm resources of wild and adapted tropical crops have never been adequately explored, collected, evaluated and utilized for the benefit of mankind. Their use can be facilitated by a single, stable service dedicated to them and coordinated with U.S. and World organizations.

RESEARCH AND DEVELOPMENTAL OBJECTIVES: Serve tropical germplasm needs by coordinating all activities associated with germplasm of tropical crops, not sufficiently dealt with in other institutions, including:

Exploration and collection

Quarantine

Screening and evaluation

Preservation in collections

Distribution

Provide a service facilitating the retrieval of information and plant material on germplasm resources, regardless of the geographical sources of such information and materials.

SUGGESTED RESEARCH AND DEVELOPMENT APPROACHES:

1. Evaluate needs and germplasm resources of major and minor crops.

2. Establish liaison and coordination with FAO activities including the International Board for Plant Genetic Resources, and with the USDA National Plant Germplasm Committee.

3. Establish communication on an international basis so that information can be retrieved and sent out periodically to all parts of the tropics. The information distribution should be coordinated through the Plant Genetic Resources Newsletter of FAO.

4. Establish a regional coordinator of tropical crop germplasm resources with functions analagous to the four existing coordinators in the four regions of the continental United States, but with specific responsibilities for the entire tropics.

5. Act as an international seed store for the tropics to furnish either seed materials or sources of seed materials except cultivars released and maintained by originators.

6. Foment, sponsor, or coordinate the collection of tropical germplasm materials of critical importance, which are being neglected, endangered, or critically needed.

7. Foment, sponsor, or coordinate special projects associated with and that will facilitate tropical plant germplasm collection, quarantine, maintenance, improvement, distribution, etc.

REGIONAL NEEDS AND APPLICATIONS: The establishment of the permanent base would require one SMY per year. This project would serve the entire tropics.

INITIATION OF THE PROJECT, AND OTHER CONSIDERATIONS: Whereas the activities of the National Germplasm programs are oriented inwards the needs of the Continental United States, the programs proposed here would be oriented outwards in response to international needs of the tropics.

As such, the proposed program cannot be conveniently funded by ARS, but merits 406 funding.

The proposal could be established on a firm footing with $50,000-$60,000 for a two-year period, and with permanent funding thereafter.

Initial personnel would consist of a project leader, a secretary, and at least one assistant.

Initiation of the program could be implemented by collecting, preserving and distributing one or more of the following crops where action is needed badly:

1. Legumes for food (including peanuts)
2. Forage Legumes
3. Tropical leafy vegetables
4. Minor fruits of American tropics.

TITLE: Minimizing the genetic vulnerability of peanuts and maintaining the wild *Arachis* species collection

PROBLEM SITUATION: A 1972 National Academy of Sciences study "Genetic Vulnerability of Major Crops" and a 1973 USDA Special Report "Recommended Actions and Policies for Minimizing the Genetic Vulnerability of Our Major Crops" emphasized the importance of genetic diversity. The need to broaden the genetic base of peanut breeding programs was illustrated at the 1971 meetings of the American Peanut Research and Education Association where it was pointed out that USA recently released Spanish varieties are all related to two widely grown varieties, Starr and Argentine and five related varieties of the Virginia type are grown on a large percentage of the U.S. acreage. The large germplasm collections available have never been brought together and uniformly evaluated and screened. Also, there is a lack of scientific knowledge in peanut cytogenetics and breeding methodology. Thus, manipulation of characters and breeding stocks has not been widely practiced.

Several desirable traits have been identified in the wild species and others will be identified as work progresses on the collection. Currently wild *Arachis* species are being maintained in several locations within the United States by several researchers. Not all accessions are maintained at all locations. None of the present locations are ideal due to a lack of facilities and personnel and to environmental conditions. In addition other species not yet collected undoubtedly exist in South America. Much of the area of origin in South America is being developed for use by modern man, thus destroying the natural habitat of many species of *Arachis*. It is imperative that the species be collected before they are destroyed.

RESEARCH OBJECTIVE: To obtain, classify, maintain and utilize genetic variability in the cultivated and wild species of *Arachis*.

RESEARCH APPROACHES:

1. The several scattered germplasm collection of cultivated peanuts, *Arachis hypogaea*, should be organized and a sustained program initiated for uniform classification, evaluation, cataloging, and maintenance.

2. A coordinated effort including the training of professional and technical personnel should be made to insure the preservation and maintenance of the present germplasm collection of wild *Arachis* species and steps should be taken to add to this collection.

3. Develop and implement basic and applied research directed toward more efficient gene management, such as breeding systems, genetic transfer in wide corsses, etc.

4. Distribute seeds and/or plants of collection to other scientists showing a genuine interest in working with the species.

TITLE: Introduction and adaptation of rare Southeast Asia fruits

PROBLEM SITUATION: Several species of choice fruits well known in Southeast Asia have never been introduced to the Western Hemisphere on a scale sufficient to test their adaptability and to popularize them.

RESEARCH OBJECTIVES: To collect superior, adapted varieties of choice Southeast Asian fruits, and to distribute these through the American tropics.

SUGGESTED RESEARCH APPROACHES:

1. Select species and varieties through perusal of the literature and through contact with local experts.

2. Obtain seed and develop seedlings for grafting.

3. Collect budwood in season in countries of origin and fly directly to the Western Hemisphere.

4. Establish superior varieties by grafting.

5. Test for adaptability in appropriate environments.

6. Multiply and release selected varieties.

This program can be handled by one scientific man year per year for 10-12 years. During the initial years the travel allowance must be very generous.

NOTE: The introduced materials will be welcomed in many experiment stations, and existing programs should facilitate further distribution.

TITLE: Production and Maintenance of Virus-Free Plant Introductions.

PROBLEM SITUATION: There is considerable risk of spreading virus disease when vegetative propagations have to be collected and distributed. This is the case for many plants such as banana or cassava. Strict quarantine requirements are sometimes contraindicated by the urgent need for new sources of nutrients. The prolonged quarantine time and costs associated with the production and preservation of virus free foundation stocks could be reduced by a more efficient system of quarantine and removal of virus infections.

Much effort has been applied to the freeing of plants from viruses by means of techniques such as chemotherapy, meristem culture and thermotherapy. However, no technique provides as yet for the integrated production and maintenance of virus-free germ plasm.

OBJECTIVES: The objectives and scope of the proposed research are: (a) The optimization and complementation of applicable techniques of tissue culture for freeing plants from viruses, and (b) establishment of a procedure for the sequential development of the steps from collection through preservation of virus free germ plasm.

RESEARCH APPROACHES: The characteristics of a project along this line would include:

1. Screening of the plant material to select the best adapted to the removal of viruses by tissue culture and to germplasm preservation.

2. The establishment of the culture-conditions and associated techniques for the freeing of viruses of specific tropical crops.

3. The tailoring of the previous conditions to clonal or varietal differences.

4. The study of the genotypic stability and potential use of germplasm preserved by tissue culture.

The estimated level of effort for this work to be completed for a representative number of species will be 2 SMY's for 4 years.

REGIONAL NEEDS AND/OR APPLICATIONS: The results of this research should make it possible to reduce the time, cost and risks involved in the quarantine and/or productions of healthy stock for tropical germplasm banks.

SPECIFIC OTHER PROJECTS:

1. Standardization of data and computerized information retrieval.

The usefulness of germplasm collections is greatly enhanced if one can readily obtain needed material with the desired genetic characteristics. This requires evaluation of the collection and compiling the data in a form that is meaningful. Uncoordinated data collection systems result in information with little real meaning and, therefore, of little value. Standardized data systems should be designed and incorporated into the germplasm programs throughout the tropics. This data system should be designed to lend itself to and be incorporated into a computerized retrieval system.

2. Development of recommendations on uniform quarantine regulations.

The transportation of living vegetative plant material throughout the world creates a potential danger of transmitting diseases, especially virus induced, that could be devastating and costly. It is important that good practical import and quarantine regulations are in effect. Under the present situation some areas are not adequately protected while others are overly protective and are unnecessarily restrictive. We recognize that countries will continue to regulate their own import and quarantine laws but we should develop reasonable guidelines, supported with scientific data, to help them establish sound and effective, but not overly restrictive regulations. We should also encourage all countries to adopt uniform regulations.

3. Development of special techniques to diagnose and rid plants of viruses.

Plant viruses present a special problem especially with vegetatively propagated species. Often viruses are difficult to detect especially at early stages of infection and once material is infected it is very difficult to clean up. Without good techniques to rid the plants of virus valuable germplasm could be lost. Research in special diagnostic and cleanup techniques should be conducted to prevent these losses and prevent further unnecessary spread of virus.

4. Development of special population methods of conserving and preserving genetic variability in bulk.

As germplasm collections get larger and larger, the physical problems of propagating and maintaining them gets overwhelming and expensive. Methods should be developed to maintain germplasm without loss of genetic variability by developing special bulk population methods. Since these methods would pool much variation, storage space would also be conserved. As our natural germplasm resources are destroyed through development, the necessity of storing large gene banks will become more important. When new disease or other problems arise it will no longer

be possible to go to areas of great diversity but we will have to depend on our stored genes. We must make sure these are adequate for the needs.

SPECIES WHERE GERMPLASM PROGRAMS ARE NEEDED:

1. Tropical forage legumes.
2. Minor legumes for food.
3. Tropical leafy vegetables.
4. Minor fruits of American tropics.

WORKGROUP ON IMPROVED MINOR HORTICULTURAL CROPS

Jose Mondonedo
Carl Campbell
Victor Nettles
Robert J. Knight, Jr., Reporter

TITLE: Development and regional evaluation of tropical and subtropical fruit cultivars.

PROBLEM SITUATION: Many areas lack improved cultivars of specific fruits, such as mango, avocado, guava, papaya, passion fruit, cashew, annonas, and sapindaceous, sapotaceous, and solanaceous fruits. Such improved fruits are needed to fill local economic and nutritional needs as well as the need for foreign exchange.

RESEARCH AND TRAINING OBJECTIVES: Evaluation of existing cultivars and selections for regional and local adaptability and acceptance, productivity, extension of bearing season, disease and pest resistance, storageability and marketability, and nutritional value. Identification, selection, and exchange of promising material.

Communication of results and distribution of selections through established agencies, for example, ministries of agriculture and universities.

SUGGESTED RESEARCH AND TRAINING APPROACHES: Through a multidisciplinary approach, replicated plantings of cultivars, and plantings of seedlings of selected material, will be grown at several regional locations to permit selection of cultivars genetically adapted to specific situations. Where applicable, laboratory screening for resistance to specific diseases will be done in conjunction with field work. Seed propagation of selected lines of papaya, passion fruit, and polyembryonic mango will be investigated. Systematic observations of the performance of test plantings will be conducted. Information so gained, and the resultant plant selections, will be shared among participants in the program. Short courses and growers' meetings will be used to disseminate the results of this research.

We estimate that 10 Scientific Man Years (2 SMY per year) will be required to complete this work within 5 years.

REGIONAL NEEDS AND/OR APPLICATIONS:

1. Fruit quality. Primitive or unselected, low-quality types of fruit are grown in many tropical countries. This observation applies particularly to mango and avocado. Experience demonstrates that poor types can rapidly be supplanted by improved cultivars when the opportunity for such a change is presented.

2. Productivity. Heavy production is essential for a viable fruit industry. This depends on the interaction of inherent characteristics and the environments, for example, Southeast Asian mangos in humid versus Indian mangos in relatively arid conditions.

3. Extension of season. Available germplasm can extend the bearing season of many fruit crops beyond their present commercial harvest period. Innovations in cultural techniques also may assist with this problem, and deserve investigation.

4. Disease Resistance. Anthracnose (Colletotrichum gloeosporioides) on mango, avocado, papaya, and lychee is a serious, widespread problem, as is powdery mildew (Oidium mangiferae) on mango and scab (Sphaceloma persicae) on susceptible avocado cultivars. Resistance to these diseases should be an important criterion in any program of evaluation and selection.

NOTE: A worthwhile project for future research is Development of Productive Cultivars of Deciduous Fruit Crops (pear, apple, peach, plum, and persimmon) for the tropics. Germplasm for such work is already assembled.

TITLE: Development and regional evaluation of vegetable cultivars.

PROBLEM SITUATION: Cultivars presently grown are in many cases inadequate to fulfill existing commercial and subsistence needs.

RESEARCH AND TRAINING OBJECTIVES: Evaluation and breeding of new and/or existing cultivars for adaptability (to region, soils, climate, and local cultural practices), for multiple disease and pest resistance, productivity, storageability, and nutritional value.

Communication of results where needed.

SUGGESTED RESEARCH AND TRAINING APPROACHES: Through a multidisciplinary approach, varietal trial plantings will be grown at two or more regional locations. Such crops would include at least tomato, pepper, eggplant, salad, vine, and bulb vegetables.

F_1 hybrids, inbreds, and synthetics will be developed and evaluated.

An interchange of ideas and plant material, as well as actual visitation of participants (on-the-job training, short courses) will be encouraged. This will assist in training the professionals, and in communicating the results of the work to the ultimate consumer, the local farmer.

We estimate that a minimum of 2 Scientific Man Years per unit region will be required to complete this work within 5 years.

REGIONAL NEEDS AND/OR APPLICATIONS: There is a need within warm-climate lands bordering the Atlantic basin for continual evaluation of vegetables of many types to supply the local populace with the best adapted varieties that meet their preferences. Examples of this would be supplying starch by plants such as aroids and yams, roughage, vitamins, and minerals by leafy and other fresh vegetables, and proteins by edible legumes.

Many presently grown cultivars seriously lack necessary disease and pest resistance, acceptable nutritional value, and desirable productivity. Improved cultivars having such qualities would enhance the nutritional and economic status of the people who grow and consume them.

For example, specific vegetable cultivars introduced more than three decades ago are grown in parts of the Caribbean, in preference to newer superior varieties, with multiple disease resistance, that are not well known locally.

TITLE: Evaluation of existing cultivars of starchy vegetables in several tropical regions.

PROBLEM SITUATION: Cultivars presently grown locally are in many cases inadequate in quality and productivity to fulfill existing commercial and subsistence needs. Some of these crops are the staple food or form part of the basic diet of many groups of people of the tropics.

RESEARCH AND TRAINING OBJECTIVES: Evaluation and breeding of new and/or existing cultivars for regional adaptability (soils, climate, and local cultural practices), for multiple disease and pest resistance, productivity, multiplication and germination problems, storageability, and nutritional value.

Communication of results where needed.

SUGGESTED RESEARCH AND TRAINING APPROACHES: Through a multidisciplinary approach, varietal trial plantings will be grown at two or more regional locations. Such crops would include at least Dioscorea, Xanthosoma, Colocasia, and Musa.

Cultivars and clonal selections will be evaluated at various locations.

An interchange of ideas and plant materials, as well as actual visitation of participants (on-the-job training and short courses) will be encouraged. This will assist in training the professionals, and in communicating the results of the work to the ultimate consumer, the local farmer.

We estimate that a minimum 10 SMY will be required to complete this work within 5 years.

REGIONAL NEEDS AND/OR APPLICATIONS: There is a need within the tropical regions for continual evaluation of starchy vegetables of many types to supply the local populace with the best adapted varieties that meet their preferences.

Priority on the kind of starchy crop would depend on the regional requirements. It could be Xanthosoma in one area, Dioscorea in another, and Musa or Colocasia in still another.

Many presently locally grown cultivars seriously lack necessary disease and pest resistance, acceptable nutritional value, desirable productivity, simple and rapid multiplication of uniformly sprouting planting materials, and storageability.

Improved cultivars and clonal selections having such qualities would enhance the nutritional and economic status of the people who grow and consume them.

WORKGROUP ON MINOR LEGUMES FOR HUMAN AND ANIMAL FOOD

Raul Abrams
A. E. Kretschmer
George Freytag
A. J. Norden, Reporter

WORKGROUP ON MINOR LEGUMES FOR HUMAN AND ANIMAL FOOD

The team first discussed the food and feed needs of the area. When the needs of West Africa are included the team arrived at quite a diverse number of research opportunities with "minor" legumes.

The final three suggestions were limited to legume crops that are adapted and are being grown and utilized to varying degrees in the area; and for which the Universities of Florida and Puerto Rico, and the ARS have the facilities and knowledge to help.

The following ten legumes were specifically discussed as being adapted to the region and are excellent sources of forage for livestock as well as providing high quality protein food for humans:

1. Pigeon peas.
2. Peanuts
3. Hyacinth bean
4. Bambarra bean
5. Cowpeas
6. Chick peas
7. Rice bean
8. Horse bean
9. Lima bean
10. Scarlet runner bean

TITLE: Development of Minor Legumes for Human and Animal Food in the Tropics, namely Pigeon pea (Cajanus cajan (L.) Millsp.).

PROBLEM SITUATION: Pigeon peas are one of the most important legume crops grown for human consumption in the Caribbean and parts of Latin America. They constitute an important part of the diet, not only because of consumer preference, but also because of their high protein content. Pigeon peas are also of great importance to the economy of this area, the farm value of the crop being estimated in millions of dollars with a very good potential for future increase. An opportunity exists now for developing a broad reservoir of germplasm with wide adaptability which would include genes for the improvement in quantity and quality of protein, new sources of disease and insect resistance, superior agronomic and physiological properties, as well as improved standard of processing.

RESEARCH AND TRAINING OBJECTIVES:

1. To develop varieties and breeding populations with broad adaptation and superior productive capacity for the major agroclimatic areas of the Caribbean and Latin America.

2. To develop practical solutions to major problems of disease and insect attacks, as well as weed competition; develop by breeding cultivars resistant to insect and disease attack.

3. To determine the major limitations on productivity on these areas, and to develop cultural techniques to overcome these limitations.

4. To develop harvest and storage methods which are efficient, suited for local conditions, and which will produce and preserve seed viability and quality of green peas for utilization.

5. To develop and demonstrate improved methods of utilization and of processing pigeon peas.

6. Provide short-term practical on-site training of personnel actively engaged in pigeon pea research and development. Limited provision will be made for more extensive formal training of a few selected individuals.

SUGGESTED RESEARCH APPROACHES:

1. Assemble and screen germplasm with special breeding value for the Caribbean and Latin America. A germplasm information system should be developed for the identification of material useful to this project and for recording of new information gained in further evaluation of such material. ISMY

2. Combine desirable agronomic characters already found in improved varieties, with broad adaptation to the Caribbean and Latin America, with high resistance to major diseases and insect pests. 10 SMY

3. Conduct trials at different locations to study optimum dates of planting plant populations, and weed control systems to maximize yield. 1 SMY

4. Devise practical and economical procedures for harvesting, seed storage and utilization. 1 SMY

REGIONAL NEEDS AND/OR APPLICATIONS: There is an urgent need of new improved varieties that should be made available to small and subsistence farmers to improve their production and their diet. The production of determinate dwarf-type cultivars will boost considerably the total production for processing of the crop and hence the farm value.

TITLE: Development of subterranean legume crops for human and animal food in the tropics, namely Peanuts, Arachis hypogaea L., Bambarra groundnut, Voandzeia subterranea, and Scarlet Runner Bean, Phaseolus coccineus.

PROBLEM SITUATION:

1. Peanuts. During the period 1965-70, West Africa produced approximately 30% of the world production of peanuts (approx. 5 million metric tons/year), compared to 7% or 1.2 million metric tons/year in the U.S. Yields in West Africa are less than half that produced per unit of land area in the U.S. and have been declining in recent years. Peanuts are widely accepted as a food and vegetable oilcrop in West Africa. The seed contain approximately 25 to 30% protein and 45 to 50% oil and the foliage provides a high quality livestock feed. Peanuts are relatively insensitive to photoperiod and belong to the large cowpea cross inoculation group which also includes pigeon peas, beans, and many others. Research shows that considerable genetic variability is present within the cultivated peanut for improving both the content and composition of the oil and protein. Varieties of peanuts developed in Florida are found to be adapted in areas of widely diverse climates. Varieties with better resistance to drought and with higher yield potential are urgently needed in West Africa.

2. Bambarra groundnut. The Bambarra groundnut originated in West Africa and is still widely used in that area as a high protein, high energy food crop. It is a very drought resistant legume with about 15% protein in the seed. This crop offers definite possibilities in the multiple cropping schemes of West Africa, but to date very little research has been done with this crop.

3. Scarlet Runner Bean. The P. coccineus group is utilized in highland tropical America by many of the indigenous people as a more or less perennial green shelled or dry bean food source. However, the wild species are found in the same areas and all produce large root stalks which might be a source of additional food or for chemical products. The uses of the root stalks have not been investigated.

RESEARCH AND TRAINING OBJECTIVES:

1. Develop, through breeding, varieties of peanuts and Bambarra nuts with better resistance to drought, higher yield potential, and improved quality.

2. Evaluate Phaseolus coccineus germplasm and identify genotypes that possess high yield potential and other desirable traits.

3. Investigate methods of breeding to improve drought resistance of peanuts.

4. Provide short term and degree program training for students and personnel engaged in research and extension with these crops.

SUGGESTED RESEARCH APPROACHES: (5 years)

1. Collect and evaluate germplasm. 1 SMY

2. Plant breeding for improved varieties. 10 SMY

3. Determine insect and disease problems and distribution, control and genetic resistance. 5 SMY

4. Develop improved production practices. 2 SMY

REGIONAL NEEDS AND/OR APPLICATIONS: Determine socio-economic factors in present areas of cultivation to indicate best methods and areas for extension of research results in Latin America. 2 SMY

TITLE: Development of minor legumes for human and animal food in the tropics, namely Hyacinth bean (*Dolichos lablab*).

PROBLEM SITUATION: The Hyacinth bean is widely used in the American tropics as a food protein source. Two principal types are generally produced on a small scale; a dark seeded type for cover crop and ornamental purposes, and a large white-seeded type for human consumption. The crop generally will be produced on the poorer soils where other crops may not be successful, thereby providing a source of food on land which might otherwise be unproductive. It also has shown a particularly good production capacity under drought conditions.

These characteristics could certainly be improved by selection and breeding as well as improvement of quality factors, thereby providing additional food to the marginal, subsistence farmer who presently is cultivating it.

RESEARCH AND/OR TRAINING OBJECTIVES:

1. Develop improved varieties of higher yield, better nutritional quality and disease and insect resistance.

2. Develop agronomic cultural practices to reduce production cost, increase mechanization and simplify production systems.

3. Provide short-term training for active legume researchers and opportunities for a small number of key individuals to pursue a degree program in specific fields.

SUGGESTED RESEARCH APPROACHES: (5 years)

1. Collect and evaluate germplasm for multiple pest resistance, nutrient composition, yield, and drought resistance. 1 SMY

2. Incorporate desired characteristics into adapted varieties. 10 SMY

3. Develop improved production practices or management programs for growers. 1 SMY

4. Develop food products and by-products, improved processing, marketing and utilization. 1 SMY

WORKGROUP ON GRASSES AND FORAGES

Antonio Sotomayor
Murray Gaskins
G. O. Mott, Reporter

TITLE: Biological nitrogen fixation

PROBLEM SITUATION: Eliminating hunger and malnutrition in underdeveloped areas is impeded by the rapidly increasing cost of chemical fertilizers. Greater use of symbiotic nitrogen fixation is one of the most promising avenues for increasing production fo food and feed crops. Recent research results indicate that certain bacterial species, living in the root zones of some tropical grass species, can fix substantial quantities of atmospheric nitrogen.

RESEARCH OBJECTIVES:

1. Evaluate tropical grasses, particularly species of Paspalum Panicum and Digitaria, with associated bacterial cultures, to determine their capability for fixing atmospheric nitrogen.

2. Organize collecting expeditions to selected areas in the tropics, to collect introductions with associated bacteria from their root zones.

3. Select cultivars and breeding lines of tropical legumes with maximum capability for nitrogen fixation under tropical conditions.

4. With both grasses and legumes, determine cultural requirements for highest fixation rates.

RESEARCH APPROACH: The recent pioneering work in Brazil must be evaluated and confirmed at other locations, and the reasons for occasional difficulty in achieving satisfactory fixation must be determined. A broad array of cultivars and bacterial strains should be studied under rigidly controlled conditions. The classical procedure for identification of microorganisms (i.e. Koch's postulates) must be fulfilled.

The problems arising from worldwide nitrogen shortages are sufficiently severe to justify immediate attention to projects which promise to provide solutions. This work would be undertaken with a minimum of 3 SMY's, adequately supported by appropriate facilities and technical assistance. The project requires funding for a minimum of 3 years, but practical application of the developed technology may well require 5 or more years. A 3-year project funded at a level not below $250,000 is recommended as minimal in view of the world wide need for the results anticipated.

REGIONAL APPLICATION: The resulting technology will be applicable throughout the tropics, and probably in all of the world's agricultural regions.

TITLE: Identification, collection, and evaluation of promising forage legumes.

PROBLEM SITUATION: Very few legume species compete successfully with grasses in pastures in the tropics. There is a great need for adapted cultivars. Greater use of legumes could improve utilization of many tropical soils not adapted for production of other crops. Also, increased forage production would help to reduce protein shortages in many areas, by increasing production of milk and meat.

RESEARCH AND TRAINING OBJECTIVES:

1. Systematically collect and identify legumes of possible value as forages, from Latin America and other tropical areas.

2. Evaluate these collections in Florida and Puerto Rico, and increase outstanding accessions for further evaluation under different ecological zones.

Use capable graduate students from Latin America to achieve these objectives.

SUGGESTED RESEARCH APPROACH:

1. A scientist familiar with tropical forages, and trained in taxonomy, plant breeding, and agronomy, would collect in Latin America, Africa and Asia.

2. The collections would be assembled at two locations (Florida and Puerto Rico). A standard evaluation procedure would be followed. The most outstanding species would be tested on three main soil types (Ultisol, Vertisol, Oxisol).

3. Further studies with support from the Universities concerned on physiology, plant pathology, entomology, management, etc. would continue toward the selection of proper forage legumes for the tropics.

Scientific Man Years (SMY)

1.	Scientists	2 (SMY)	$40,000
2.	Graduate Students	4 (SMY)	20,000
3.	Secretary, Laborers, etc.	1 (SMY)	20,000
	Total		$80,000
4.	Travels, materials, etc.		10,000
			$90,000

REGIONAL NEEDS AND/OR APPLICATIONS:

1. The utilization of adapted forage legumes would increase the productivity of pastures and reduce fertilizer costs on millions of acres in the tropics.

2. The proper utilization adapted of forage legumes would improve soil texture, help control erosion, and protect valuable land resources in the tropics.

TITLE: Animal evaluation of forage selections

PROBLEM SITUATION: There are many introductions and breeder lines already available at various experimental stations. These have not been evaluated in the field by the ruminant animal for either yield or quality. To reduce the risk of releasing unadapted cultivars it is imperative to screen selections by exposing them to the grazing animal to determine their response to animal defoliation and their quality in terms of animal production.

RESEARCH AND TRAINING OBJECTIVES:

1. To study the response of tropical grasses, legumes and legume-grass associations to defoliation by the grazing animal.

2. To study the animal response to consumption of tropical grasses, legumes, and legume-grass associations.

3. To train technicians in the methodology of forage evaluation so that they will have the capability of recognizing superior germplasm, management practices, and forage-livestock feeding systems.

REGIONAL NEEDS AND/OR APPLICATION: The products of this research program will be measured in terms of superior cultivars of grasses and legumes for tropical and subtropical America. The results will also permit the development of systems of fertilizing forages and grazing management practices which will maintain legume-grass associations and optimize yield and quality of feed on offer. If the research is properly done with appropriate experimental designs, the coefficients generated should be applicable to the small farmer as well as to the corporate farmer, regardless of his location. Local adaptation of the information obviously will be necessary, but the basic data should have wide application.

Close collaboration between the various testing stations will be needed to ensure a minimum of duplication, yet sufficient to provide results which have wide application.

SUGGESTED APPROACHES: The resources for the animal evaluation of tropical forages does not exist in most of the experimental stations in the American tropics and subtropics. The screening of the mass of germplasm available in the tropical grasses and legumes is almost entirely restricted to agronomic and laboratory evaluation (quality) in the introduction and breeder's gardens and in small plot clipping trials. Facilities are urgently needed at two or more locations in each of Florida,

Puerto Rico, the Virgin Islands, and several South American countries. The locations should represent a wide spectrum of environmental conditions so that the release of a cultivar will have as wide an adaptation as possible.

Six SMY's will be required at each location to complete the research in 5 years. The initial cost of each installation will be approximately $150,000 for fencing, water system, equipment, service buildings, preparation of land, and establishment, but not including the land. An animal operating budget of $15,000 to $20,000 should be sufficient after the original installation cost plus the SMY's.

WORKGROUP ON SOIL FERTILITY AND MANAGEMENT

F. H. Beinroth
F. G. Calhoun
J. Vicente-Chandler
W. G. Blue, Reporter

TITLE: Development of screening techniques for aluminum tolerance in plants based on an understanding of the nature of aluminum tolerance.

PROBLEM SITUATION: Many tropical soils have toxic quantities of aluminum in their surface and subsoils. Development of plant root systems is restricted, which reduces nutrient utilization efficiency and utilization of moisture stored in the subsoil.

Surface aluminum is easily detoxified through liming. Subsoil aluminum toxicity is less readily corrected. Lime is not always available, especially for the small farmer in remote areas.

RESEARCH AND TRAINING OBJECTIVES:

1. To study the nature of aluminum toxicity and of plant tolerance to aluminum.

2. To develop mass screening techniques for aluminum tolerance by plants.

SUGGESTED RESEARCH APPROACH: Five SMY's

REGIONAL NEED: Hundreds of millions of hectares of soils classified as Ultisols and Oxisols have toxic quantities of aluminum. It may be economically feasible to apply and incorporate lime for detoxification of aluminum throughout the potential rooting zones.

TITLE: Identification of soil characteristics related to nitrogen fixation by grasses and their alteration to enhance nitrogen fixation.

PROBLEM SITUATION: Tropical soils are deficient in available nitrogen. Fertilizer nitrogen is expensive and frequently unavailable. It has recently been shown that some tropical grasses fix atmospheric nitrogen through association with bacteria. The effectiveness of this symbiosis appears to be related, in part, to some soil characteristics.

RESEARCH AND TRAINING OBJECTIVES: To identify and modify soil characteristics related to the efficiency of nitrogen efficiency of nitrogen fixation by tropical grasses.

SUGGESTED RESEARCH APPROACHES: Three SMY's

REGIONAL NEEDS: Most of the food grains and forages are derived from grasses. Nitrogen is deficient for economical yield expression of these plants. This type of nitrogen fixation will increase plant production and food availability throughout the tropics at minimum cost.

TITLE: The efficiency of native and applied phosphorus for tropical crop production.

PROBLEM SITUATION: Tropical soils are deficient in available phosphorus. They absorb large quantities and transform it into compounds with limited availability to plants. Known phosphorus reserves are limited and fertilizer phosphorus is expensive and frequently unavailable.

RESEARCH AND TRAINING OBJECTIVES: To develop techniques which will optimize the efficiency of native and applied phosphorus.

SUGGESTED RESEARCH APPROACHES: 8 SMY's

REGIONAL NEEDS AND/OR APPLICATIONS: Hundreds of millions of hectares of tropical soils classified as Inceptisols, Alfisols, Ultisols, and Oxisols are deficient in available phosphorus for most crop production.

OTHER HIGH PRIORITY RESEARCH AREAS:

1. The role and effect of soil organic matter on tropical crop production.

2. The impact of Multiple Cropping on soil productivity.

3. Development of methodology for transfer of technology through soil survey and classification.

WORKGROUP ON INSECT PESTS OF PLANTS

Mario Perez-Escolar
A. K. Burditt
Derrell Chambers
R. M. Baranowski, Reporter

TITLE: Mass rearing procedures and sterilization techniques for *Toxatrypana curvicauda* suppression

PROBLEM SITUATION: The papaya fruit fly is the limiting insect pest of papaya fruit production in the Caribbean and is a potential pest for other papaya growing areas. Infestations vary considerably, but typically increase as production increases. Often as much as 30% of the fruit can be destroyed and on occasions 100% of the fruit can be infested.

Since work on papaya diseases is currently underway (1975 proposal), this project would complement that work.

RESEARCH AND TRAINING OBJECTIVES:

1. Develop procedures for mass rearing the papaya fruit fly.

2. Determine sterilization dosages.

3. Train technical personnel in rearing and sterilization procedures for a possible small island eradication program.

RESEARCH APPROACH: Since the sterilization studies will be dependent upon the availability of an adequate supply of flies, the primary efforts will be directed toward rearing procedures. The development of a satisfactory larval diet is usually the most difficult hurdle in fruit fly rearing. Diets prepared from papaya fruit and diets utilized by other fruit flies will be tried initially. Egging devices made of paraffin impregnated cheesecloth are known to be acceptable to occasional individuals. It is anticipated that a laboratory strain that would readily oviposit in artificial devices could be developed in 8-10 generations.

Once production methods are developed, studies will be initiated, using a gamma source, to determine sterilization dosages.

It is estimated that 3 SMY's (1 per year) will be needed for the rearing studies, 1.5 for the sterilization dosage studies and 1.5 for preliminary field evaluation, over a 3 year period.

REGIONAL NEEDS AND/OR APPLICATIONS: Methods developed would be applicable to papaya fruit fly suppression or eradication programs throughout the western tropics or if the need arises, in the eastern tropics. The general procedures developed and the training obtained would be adaptable to other fruit fly species present in the New World.

TITLE: Studies on the biology and acult behavior of Cosmopolites sordidus

PROBLEM SITUATION: The insect, specific to the Musaceae, is an introduced pest in the New World. Practically all banana growing regions in the Western Hemisphere are affected by this insect. Along with nematodes, root borer infestations considerably reduce the possibility of economical 2nd and 3rd year crops. With the increasing interest in banana species and the reduced number of effective pesticides available, damage by this insect will increase.

Although there is a considerable amount of literature on this insect, there is little biological information based on current behavioral concepts necessary for good pest management practices.

RESEARCH AND TRAINING OBJECTIVE:

To determine if chemical or physical cues or signals play a significant role in aggregating on mating behavior and if this behavior can be utilized in population suppression.

SUGGESTED RESEARCH APPROACH:

1. A complete study of basic field biology with emphasis on adult behavior.

2. Determine the attraction of adults to cut banana tissue and how this tissue on products derived from this tissue can be utilized in trapping programs. This would complement the partial control obtained from the chemicals used for nematode control. 5 SMY's, 1 per year

REGIONAL NEEDS AND/OR APPLICATION:

The results would be applicable to suppression programs in all part of the borers range with anticipated production increases.

TITLE: Studies on the Biology and Behavior of Diaprepes abbreviatus.

PROBLEM SITUATION: This insect attacks a wide range of ornamental, forest and food plants, feeding on roots, underground edible portions and foliage. More than 50 species of plants are known hosts, the most important of which are sugar cane, citrus and yams. It is known that adults of this insect aggregate in large numbers in certain plants such as Spondias. This aggregation phenomenon may be due to a response to a chemical produced by the plant, or by a chemical produced by the insects or by a combination of factors.

RESEARCH AND TRAINING OBJECTIVES: Determine the cause of the aggregation and whether the causal agent can be used in a suppression program.

SUGGESTED RESEARCH APPROACH: Efforts should be directed toward intensive studies of the behavior of this insect and initially to its reaction to extracts of host plants as well as extracts of both sexes of various ages. 5 SMY's, 1 per year

TITLE: Development of Technologies for Improved Management of Caribbean Fruit Fly Populations

PROBLEM SITUATION: Flies belonging to the genus Anastrepha are among the major insect pests in the Western Hemisphere tropics. This genus contains well over 100 species, the majority of which attack plants that are used for food. Several species are of considerable economic importance. Notably among these is the Caribbean fruit fly, A. suspensa. This pest is known to infest over 80 hosts ranging from Florida to Puerto Rico, Jamaica and Hispaniola. Other serious pests are the Mexican fruit fly, A. ludens attacking citrus and mango, A. fraterculus, primarily a pest of mango, guava and citrus, and A. mombinpraeoptans, also a pest of mango and guava. Many other species are potentially economically important wherever cultivation of host crops is intensive. Crop destruction by several of these species would very likely be explosive if they were accidentally introduced into a new environment without the biological agents that would, in the original range, maintain some type of equilibrium. An example of this is the accidental introduction of A. suspensa into Florida.

RESEARCH AND TRAINING OBJECTIVES:

1. Determine the most effective parasite or combination of parasites that can be utilized against the Caribbean fruit fly and other species of Anastrepha.

2. Develop a combination of technologies such as innundative rarasite release, utilization of attractants, sterile insect release and bait stations that can be used to suppress or eradicate fruit fly populations.

SUGGESTED RESEARCH APPROACHES:

1. Survey areas where A. suspensa and other species occur naturally for biosuppressive agents.

2. Study these agents in the field and in the laboratory to select those that have the behavioral and biological potential for utlilization.

3. Study A. suspensa throughout its range; collect specimens ecologically and host specifically isolated for genetic analysis and for comparison with lab cultures potentially useful for research and eradication programs.

4. Select an isolated area such as Key Biscayne, Florida where adult trapping and fruit infestation data has been collected over a period of years.

5. Determine the number of parasites necessary to substantially reduce existing populations and make necessary releases. This would

in large part be based on data from cooperative research between the University of Florida, IFAS and the USDA, ARS.

6. Determine the area from which chemicals now available or currently under investigation can attract adults for destruction by traps, etc.

7. Determine the number of sterile flies necessary to eradicate A. suspensa following the parasite releases. This would be developed from the cooperative research on Key West by USDA (ARS and APHIS), the University of Florida, IFAS and the Florida Department of Agriculture and Consumer Services, Division of Plant Industry.

When the fruit fly population reaches the lowest practical level obtainable with innundative parasite releases, incorporate the other suppressive techniques into the program.

6 SMY's per year for 3 years.

WORKGROUP ON INSECT PESTS OF MAN AND ANIMALS

Jenaro Maldonado
J. F. Butler
D. E. Weidhaas, Reporter

TITLE: Economic damage thresholds and control of flies and lice of cattle.

PROBLEM SITUATION: The production of meat and milk for world food supply must be increased. Research in the USA and other developed countries has shown that the presence of certain flies such as horn flies and house flies and cattle lice such as the cattle tail louse can decrease meat and milk production by direct reduction in weight gains and milk production as well as indirectly by contamination. Populations of these insects exist in tropical areas in densities equal to or greater than densities which have been shown in the USA to be above the economic threshold damage level. Therefore research on economic threshold levels in tropical areas would define the magnitude of loss of food production and the usefulness of available control techniques in increasing available food supplies.

RESEARCH OBJECTIVES:

1. Survey for primary arthropod pests of cattle in meat and milk producing areas of tropics.

2. Delineation of seasonal population densities of primary pests.

3. Evaluate available control technologies, particularly insecticides in problem areas.

4. Determine economic threshold damage levels and extent of losses in food production.

5. Train personnel in developing countries in techniques and control strategies.

SUGGESTED RESEARCH APPROACHES: Determine, through adequate surveys, population levels and economic damage accruing in selected sites in tropical areas of the USA such as Puerto Rico. Demonstrate statistical design for correlating population density, control techniques and economic damage (including thresholds). Develop short courses and on the job training for technical support in problem areas. Transfer technology and training to tropical areas.

Estimated level of support: 20 SMY

REGIONAL NEEDS AND/OR APPLICATIONS: Throughout the tropical and subtropical areas of the USA and other countries, flies and lice of cattle

occur in sufficient numbers to decrease food production. The elucidation of economic threshold levels and total economic losses would provide needed information on potential increases in food production. A considerable amount of research is being directed toward the development of methods of control other than insecticides and source reduction. This proposal would provide basic information on this problem as well as demonstrate the ability to transfer technology and train personnel in other areas

TITLE: Host specificity and control of Boophilus microplus (Canestrini)

PROBLEM SITUATION: The tropical cattle tick limits livestock development in tropical areas through direct host damage and/or transmission of Babesia bigemina and Anaplasma marginale to cattle. (1) These diseases limit shipment of animals as well as loss due to animal death. (2) Eradication of this tick has been demonstrated and may be accomplished in isolated tropical areas. (3) Eradication techniques are presently limited because of insecticide resistance and the need for improved chemical control. (4) The presence of alternate hosts in tropical areas and the lack of knowledge of host specificity for B. microplus limit the application of control and eradication technology.

RESEARCH AND TRAINING OBJECTIVES:

1. Determine host specificity on cattle, sheep and goats for control or eradication under island conditions.

2. Develop alternative insecticide controls more suitable for tropical agriculture.

3. Determine field evaluation of tick control measures.

4. Train (on the job) field scientists to carry on established techniques.

SUGGESTED RESEARCH APPROACHES: 5 SMY

Survey and determine presence of reproducing populations of ticks on susceptible hosts. Determine if ticks are present on alternate hosts without the presence of cattle or horses.

Evaluate the effectiveness of treatment techniques presently used on other tick species. Test the most suitable treatments under tropical field conditions against B. microplus.

Use the most effective compounds and control techniques to attempt tick removal from test areas. Use the trained personnel for the on-site field trials.

REGIONAL NEEDS: Techniques developed could be used for direct use in the tropics for major livestock tick and disease control. This information would then be available if this tick should be introduced into the southeastern United States as well as support to the present problem of B. annulatus control in the southwestern United States.

1. Biological Controls of Insects Affecting Man and Animals. The advent of resistance among an increasing number of insects of medical and veterinary importance to modern insecticides in the last decades naturally produced a turn to other alternatives. A renewed search and search emphasis for natural enemies of these insects is evident from the literature. The search in the Antilles, however, has been limited to Puerto Rico and Jamaica. There is no research along these lines in this area.

The great differences in numbers of Musca domestica, Dermatobia hominis, and Stomoxys calcitrans between Puerto Rico and the Dominican Republic suggest that efficient natural control is taking place. We are aware that efficient natural control is taking place. We are aware that sanitation is playing a part in this situation in Puerto Rico but this alone does not explain the scarcity of flies in the island.

It is clear that the increasing costs of available insecticides, the resistance problem, the money involved in developing new insecticides, the specificity of narrow-spectrum insecticides require that biological control play an important part in integrated control and population management programs. Thus, this subcommittee considers that a thorough search for parasites, predators, and pathogens of the above-mentioned insects and complementary studies on their development as control agents is an urgent and promising project to be carried out in the Antilles and other tropical areas.

2. Control of Torsalo, a pest of animals and man. In tropical and subtropical areas of Central America and the northern part of South America, Torsalo (Dermatobia hominivorus) also known as the human bot fly is an import economic pest of cattle and man. Heavy infestations can cause animal death, reduction in weight gains, damage to hides and even infections in humans. Improved methods of control are needed to improve meat production, particularly in Central America.

WORKGROUP ON PLANT DISEASES

R. A. Conover
Alejandro Ayala
Pedro Melendez
N. G. Vakili, Reporter

TITLE: Virus diseases of food crops (Includes: Pigeon peas, cowpeas, dry beans, yams, taro, sweet potato, and bananas).

PROBLEM SITUATION: These diseases are widespread and often are destructive to the extent that yields are greatly reduced.

RESEARCH AND TRAINING OBJECTIVES: Identify various virus diseases present in the tropics, determine their mode of transmission, and develop control methods. Graduate and trainee use for higher degrees and short-term studies.

SUGGESTED RESEARCH APPROACH: Identification by serology and differential host inoculation, determine host-vector relationships and other modes of transmission. Find sources of resistance and develop multiple resistant cultivars. Develop virus-free propagating material.

3 SMY's for 5 years for legumes and root crops each: identification - 1 SMY; sources of resistance - 1 SMY; and breeding - 1 SMY.

REGIONAL NEED AND/OR APPLICATION: Common throughout the tropical region.

TITLE: Nematode diseases of root crops and bananas.

PROBLEM SITUATION: Phytoparasitic nematodes are widespread in tropical soils and are one of the limiting factors in banana and yam production.

RESEARCH AND TRAINING OBJECTIVES: Determine the extent of damage caused by different nematode species, determine their population dynamics, and develop control methods. Graduate and trainee use for higher degrees and short-term studies.

SUGGESTED RESEARCH APPROACH: Study the economic threshold, screen for sources of resistance, develop cultural methods which reduce infection, and develop chemical control methods.

2 SMY's for 5 years. Identification and population dynamics - 1 SMY; and control - 1 SMY.

REGIONAL NEED AND/OR APPLICATION: Common throughout the neotropical region.

TITLE: Nematode diseases of root crops and bananas.

PROBLEM SITUATION: Phytoparasitic nematodes are widespread in tropical soils and are one of the limiting factors in banana and yam production.

RESEARCH AND TRAINING OBJECTIVES: Determine the extent of damage caused by different nematode species, determine their population dynamics, and develop control methods. Graduate and trainee use for higher degrees and short-term studies.

SUGGESTED RESEARCH APPROACH: Study the economic threshold, screen for sources of resistance, develop cultural methods which reduce infection, and develop chemical control methods.

2 SMY's for 5 years. Identification and population dynamics - 1 SMY; and control - 1 SMY.

REGIONAL NEEDS AND/OR APPLICATION: Common throughout the neotropical region.

TITLE: Root rot of food crops (Food crops include: pigeon peas, cowpeas, dry beans, taros, yam, sweet potato).

PROBLEM SITUATION: Limiting factor in production.

RESEARCH AND TRAINING OBJECTIVES: Identify the most severe root rot diseases, study [illegible], and develop control methods. Graduate and trainee use for higher degrees and short-term studies.

SUGGESTED RESEARCH APPROACH: Find sources of resistance and breed for multiple resistance cultivars, develop bio-control and cultural methods in order to reduce disease incidence and severity.

4 SMY's for 5 years (legumes only): Identification and epidemiology - 1 SMY; sources of resistance - 1 SMY; breeding - 1 SMY; biocontrol - 1 SMY.

REGIONAL NEEDS AND/OR APPLICATIONS: Common throughout the tropical region.

TITLE: Rust diseases of edible legumes.

PROBLEM SITUATION: A limiting factor in production.

RESEARCH AND TRAINING OBJECTIVES: Characterize the disease both on the beans and pigeon pea, study epidemiology, and develop control methods. Students and trainees can study epidemiology and control methods.

SUGGESTED RESEARCH APPROACHES: Seek sources of resistance, breed for multiple factor resistance, develop cultural methods which would minimize losses, develop chemical control.

3 1/2 SMY's for 5 years: Identification and epidemiology - 1 SMY; sources of resistance - 1 SMY; control - 1 SMY; and breeding - 1/2 SMY.

REGIONAL NEED AND/OR APPLICATION: Common throughout the tropical region.

WORKGROUP ON WEEDS

J. R. Orscheln, Reporter

TITLE: Chemical weed control for small-scale production of food crops in tropical areas.

PROBLEM SITUATION: Culture of food crops on a small scale is essential to the survival of millions of inhabitants of tropical areas. Production is based on myriads of small holdings where unsophisticated individuals raise many and diverse seed and vegetatively propagated annual and perennial crops. Broken terrain, small parcel size, and intercropping would limit mechanical tillage even if equipment were available. These tropical areas are marked by little salaried employment opportunity, low wage scales, and an abundant labor supply. Manual weed control is a reasonable practice even though it is transient and non-selective.

Herbicides offer the opportunity for selective and residual weed control during the critical crop establishment period especially. Use of such tools is difficult for the small tropical grower who has limited skill, experience, and equipment for precise chemical application.

RESEARCH AND TRAINING OBJECTIVES:

1. Develop chemical weed control systems based on registered herbicides or herbicide combinations suitable for production of mixed or inter-tilled seed and vegetatively-propagated tropical food crops.

2. Develop simplified application techniques to ensure reasonable grower precision in application.

3. Train "extension-type" personnel in using the system and in demonstrating it to growers.

SUGGESTED RESEARCH APPROACHES: Est. 5 SMY

1. Utilize the literature to select commercially available preemergence herbicides with wide-spectrum crop selectivity and general weed susceptibility.

2. Evaluate these chemicals on a wide array of common tropical crops, e.g., fresh vegetables, aroids, fresh and dry edible legumes, grains including maize, squashes, yuca, yams, sweet potatoes, and other root and tuber crops. Determine weed control and crop performance.

3. Assemble and test compatible crop/herbicide groups as mono- and mixed-cultures and determine weed control and crop performance.

4. Develop simple methods for grower application of these chemicals, e.g., granules, impregnated mulches, etc.

REGIONAL NEEDS: The terrain of tropical regions is stippled with countless "milpas" or "conucos", small patches of land cultivated for food production. Patches may be shifted frequently; their size is limited by the ability of the grower (and his family unit) to combat the ubiquitous and relentless pressure of weed competition after the first several crops have been harvested. Simple herbicide systems can facilitate larger patch size, longer tenure, and improved yields.

TITLE: Cultural systems to minimize weed competition in small-scale tropical food crop production.

PROBLEM SITUATION: Mechanical cultivation and herbicides are accepted practices for controlling weeds in many agronomic, horticultural, and plantation food crops on a commercial scale in tropical areas. Unfortunately, these methods are ill-suited, too expensive, and too sophisticated to be scaled-down for the small grower. The small producer is accustomed to diverse food crops and available low-cost labor. He could learn readily the rudiments of crop management to take advantage of natural and cultural means of weed suppression.

RESEARCH TRAINING OBJECTIVES:

1. Develop management practices (including terrain preparation, fallowing, mulching, rotations, and intercropping) which maximize early growth of specific crops and which suppress weeds.

2. Train "extension type" personnel in using and in demonstrating these systems.

SUGGESTED RESEARCH APPROACHES: Est. 5 SMY

1. Utilize the literature to assemble available knowledge and existing useful systems.

2. Evaluate available acceptable crop cultivars for characteristics which maximize crop competitive ability against weed competition, including stature (habit), height, shading, precocity, bearing area, and natural toxins.

3. Combine and evaluate the most promising cultivars with natural mulch, interplanting, and rotation.

4. Develop chronological or sequential cultural and production programs for grower use.

REGIONAL NEEDS: The numerous small-scale food crop growers in tropical areas lack agricultural sophistication and financial resources. Their needs could be met partially by development of weed control systems which they can understand, can manage, and can afford.

TITLE: Biological control of waterhyacinth using insects.

PROBLEM SITUATION: Waterhyacinth (Eichhornia crassipes) is the most serious aquatic weed in many of the Caribbean islands. Puerto Rican agriculture relies on rivers and canals for drainage and irrigation, and clearing the waterhyacinths by mechanical and chemical means may be prohibitively expensive.

RESEARCH AND TRAINING OBJECTIVES:

1. Import to Puerto Rico the several beneficial insects which have been found useful in suppressing waterhyacinth in Florida (USA). Test these insects under quarantine conditions with selected Puerto Rican plants prior to release of the insects in the island.

2. Establish the insects using techniques developed by ARS in Florida for safe and effective release.

3. Train university or government personnel to monitor the populations and to spread the insects to new waterhyacinth sites as the initial populations become large enough.

SUGGESTED RESEARCH APPROACHES: Est. 1 SMY

1. Set up research facilities at University of Puerto Rico Experiment Station (Rio Piedras).

2. Consult with interested persons as to which plants in Puerto Rico should be tested.

3. Import test insects, conduct tests, submit report on results to appropriate authorities, retest, if needed.

4. If approved for release, establish field sites and monitor monthly.

REGIONAL NEEDS: The economy of many areas of the Caribbean does not allow widespread use of sophisticated machinery or expensive chemicals for control of waterhyacinth. A reduction in the abundance of this weed through biological control should result in a savings in money and energy spent to control the weed and an improved efficiency in draining and irrigating fields.

WORKGROUP ON SMALL ANIMALS

L. R. Arrington
J. H. Conrad
J. H. Sanfiorenzo, Reporter

TITLE: Study of the economic potentialities of some breeds or lines of goats developed as meat producers in the Caribbean or adjacent areas.

PROBLEM: A variety of goats intended for meat purposes are found in many of the Caribbean Islands but due to low productive and reproductive rates their commercial production is not economical. However; there is evidence that in some countries of South America high productive meat goats have been developed which will probably do as well in other tropical areas. Goats are ruminants and have the inherent ability to efficiently and economically convert forages and fibrous by-product feeds to highly nutritious animal protein.

In Puerto Rico, the low productive and reporductive rates and the strong demand for this type of meat is reducing their population numbers to such levels that there is practically no source of goats to start even small size operations.

RESEARCH AND TRAINING OBJECTIVES:

1. Increase food production by increasing the quality and number of goats in the tropics.

2. Conduct economical studies of some of the more promising lines of meat goats available.

3. Train students in Animal Production by using goats as sources of food and provide short-term training for personnel.

SUGGESTED RESEARCH APPROACH: Locate some of the most productive lines of meat goats developed in some of the Caribbean Islands as in South American countries from which acquisitions can be made. Conduct economical comparisons of the productive and reproductive levels of these lines and encourage the selection and use of the superior or more adaptive ones. 3 SMY's for 5 years research.

REGIONAL NEEDS: Many thousands of steep acres of land not suitable for agronomic uses nor for cattle grazing can be used very efficiently to increase animal production by means of goats.

TITLE: Study of the productive and economic potentialities of guinea fowl under confinement.

PROBLEM: The Guinea Fowl is becoming more and more popular as a source of animal food in many tropical countries, but due to lack of adequate knowledge and proper management practices, population numbers are very low and prices enormously high.

RESEARCH AND TRAINING OBJECTIVES:

1. Increase sources of animal food production in the tropics.

2. Study productive levels, management practices, proper rearing, and other economic aspects of the guinea fowl under confinement.

3. Train students of Animal Science by conducting research projects on these types of birds and provide short-term training for personnel.

SUGGESTED RESEARCH APPROACH: Study the economic potentialities of the guinea fowl as a source of food by conducting a series of short research projects leading to the development of information on the proper management, feeding, and rearing of these birds. Compare the performance and consumer's preference of the white and gray guinea fowl. 2 SMY's for 3 years research.

REGIONAL NEEDS: Many farmers in the tropics are seeking information about the proper rearing of guinea fowl under confinement. Unfortunately, no research information is available to answer their questions.

TITLE: The development of rabbit production systems for tropical environments.

PROBLEM SITUATION: Increased protein production and consumption by economically disadvantaged people is an undisputable goal. Many low income families in tropical regions live on small farms which produce forage throughout the year. In most situations this forage resource is poorly utilized. The rabbit, a herbivora, has the inherent ability to efficiently and economically convert forages and fibrous by-product feeds to highly nutritious animal protein. Adaptive research is greatly needed to develop the best rabbit production systems under tropical environments.

RESEARCH AND TRAINING OBJECTIVES:

1. To increase protein production and consumption of economically disadvantaged rural families.

2. To develop low-cost rabbit production systems which will efficiently and economically convert tropically produced forages and fibrous by-products to nutritious meat.

3. To train people in the techniques of rabbit production under small-scale conditions in a tropical environment.

4. To publish research results and information which can be used as production guides.

SUGGESTED RESEARCH APPROACH: Rabbits possess a series of unique characteristics. They are prolific in that they produce litters of 6 to 8 young during a 32-day gestation period and these animals can reach 4 pounds liveweight at 8 weeks of age. Thus, four or more litters can be produced per year on diets in which the major portion is pasture and forage. Little research has been conducted to develop production systems under tropical environments, although this animal is an efficient meat producer utilizing forage and non-competitive feedstuffs.

Consequently, research needs to be conducted to study: adaptation, management systems, performance of single cross F_1 offspring, feeding programs utilizing locally produced forages and by-product feedstuffs, effect of fiber level on performance, housing and production practices. Sufficient data would be collected for the determination of protein produced per unit of feed consumed and the calculation of the economics of production. Training would be with Animal Science students and producers in the techniques of production.

Scientific Man Years are estimated to be 0.5 per year during 5 years for a total of 2.5.

REGIONAL NEEDS AND/OR APPLICATION: Most economical rabbit production systems developed for Puerto Rico, Virgin Islands or Florida should require a minimum of adaptive research prior to its application for other tropical areas.

WORKGROUP ON MECHANIZATION

W. F. Allison
L. N. Shaw
L. W. Larson, Reporter

TITLE: Mechanization on small farms in the tropics.

PROBLEM SITUATION:

1. Labor intensive agriculture with little or no mechanization limits production capacity.

2. Minimum mechanical experience of subsistence farmers indicates need for transition period before full mechanization is feasible.

3. Lack of delivery system for fuel, service, and parts limits application of power driven equipment in isolated sections of many countries.

4. Many small farms located in less desirable areas.

5. Lack of capital for purchasing tools and equipment.

RESEARCH AND TRAINING OBJECTIVES:

1. Improve manual methods to make labor more productive, thereby increasing overall output.

2. Increase substitution of mechanical techniques for human labor.

3. Prepare subsistence farmers, by education and training, for greater use of mechanized equipment.

SUGGESTED RESEARCH AND TRAINING APPROACHES:

1. Study current production techniques on subsistence farms, including land preparation, cultivation, pest control, and harvesting to determine promising areas for improvement through mechanization.

2. Search for equipment on a world-wide basis, especially the Far East and Europe. Test and evaluate operation of selected items under field conditions to determine feasibility for use.

3. Modify promising selected items to improve usefulness for specific tasks.

4. Develop delivery procedures for training in use of equipment and techniques found to be of economic value.

Estimated level of effort: 2 SMY per year for 5 years, for a total of 10 SMY.

REGIONAL NEEDS AND/OR APPLICATIONS: For mechanization, categorize regions by topography and soil type.

Small farms are generally located on less desirable land, since level, well-drained land of good fertility will have been taken up for other purposes. In Puerto Rico, for instance, there are 13,000 subsistence farmers in 20% of the land area, while 600 commercial farmers hold 80%.

Characteristics of subsistence farms: moderate to steep slopes; relatively shallow soil, often rocky mixed soil type; small plots, irregular shaped.

Devices, techniques, and systems should fit the needs of these regions.

WORKGROUP ON APPLICATIONS OF FOOD TECHNOLOGY TO TROPICAL FOOD RESOURCES

Miguel Gonzales
Robert Berry
R. P. Bates, Reporter

SCOPE: Food Technology may be broadly defined as the intelligent use of the resources available: (1) to affect the maintenance, optimization or improvement of natural or potential food materials, (2) to prepare them to withstand adverse physical, chemical and biological stress, (3) to make them easier and more convenient to handle and use in safe, wholesome, nutritious form.

This is a highly interdisciplinary activity involving the basic and applied sciences and engineering and can only function effectively in close cooperation with the agricultural community. A number of TAD workgroups have identified important areas where joint cooperation with food technologists would be quite valuable.

Areas which interface with food technology are:

Germplasm preservation, Horticultural crops, Minor legumes, Small Animals - processing and product research with raw materials, mentioned in specific workgroup reports.

Mechanization - food handling, processing, packaging and distribution.

Social impact - food acceptance patterns and attendant quality attributes. In addition the appreciable but under-utilized marine resources of the tropics are well worth food technology efforts.

Due to the high energy (sunlight and rainfall) availability, tropical areas have a great potential for making substantial contributions toward lessening anticipated future world food problems. This will not be possible, however, without use of food technology to develop food resources into stable, acceptable nutrient dense products which can be made available to areas remote from the regions of their production.

TITLE: Postharvest handling, preservation and distribution of tropical commodities.

PROBLEM: There are appreciable losses of tropical crops from harvest to consumer. These losses, due to improper handling methods or neglect of rudimentary precautions result in lower nutritive value, unsafe sanitary conditions, and ultimately in reduced income to the farmer and higher food prices to the consumer. Improved food handling practices can lead to increased food quality and availability at reduced cost.

OBJECTIVES:

1. To determine optimum conditions for handling, storing and packaging foods under the constraints of tropical conditions.

2. To provide training in practical food handling techniques for all links in the food-chain producer, packer, processor and retailer.

APPROACHES:

1. Survey current causes, characteristics and magnitude of crop losses.

2. Apply simple methods to improve present storage, handling and distribution using already available and adaptable techniques.

3. Investigate problems specific to special crops in the light of existing research facilities and availability of human resources.

4. Work closely with breeders in assessing postharvest characteristics of promising breeding lines.

5. Disseminate related information, both original findings and existing knowledge, via appropriate educational programs.

NEEDS/APPLICATIONS: In tropical developing countries most foods are badly handled. Sometimes this may be corrected by simple education and minor technical inputs. In other cases, vast changes in the total agricultural infrastructure from production to marketing, are required. The economic importance of a specific food and the ease with which handling deficiencies can be corrected will dictate commodity priority.

TITLE: Adaptation and development of simple processing techniques.

PROBLEM: Food processing as practiced in developed countries are extremely sophisticated, large-scale, capital-intensive undertakings. Such operations are usually impractical in developing countries, yet wasteage due to the inability to process certain crops during a limited season of availability is appalling. Conversion of raw foods to products can promote storage stability, extend availability and expand market potential. While some conventional processes are adaptable, others are completely impractical while still others need to be extensively modified.

OBJECTIVES:

1. To adapt food processing technology to small scale, low capital, labor intensive situations without sacrificing food safety or quality.

2. To train all levels of food industry personnel in the basic principles of food processing, sanitation and quality to enable them to become more self-sufficient and innovative regarding utilization of the indigenous food supply.

APPROACHES:

1. Survey limited scale or small industry processes in accordance with availability of raw material, labor and community needs.

2. Investigate the feasibility, design and applicability of community canning centers in conjunction with farm cooperatives and farmer markets.

3. Develop training programs to increase awareness of the importance of mechanical know-how and equipment design using local materials.

4. Develop methods for applying simple dehydration, fermentation, smoking and canning procedures to traditional and new food sources.

5. Develop new food products from tropical foods to make their nutrient and food value transportable to remote areas.

NEEDS/APPLICATIONS:

1. Spoilage of the catch often results in losses preventable by simple preservation methods designed for the small fisherman.

2. In the Southern Region there are many perishable crops which should receive special emphasis. Once appropriate processing methods are developed, these foods may be systematically evaluated.

3. Self-sufficiency in the processing of specialty items - condiments, ketchup, mustard, pickles, peanut butter, etc. is readily achievable.

4. In general, technology transfer needs to be refined with emphasis upon economy of scale, energy and labor optimization.

TITLE: Nutritional, safety and quality attributes of tropical foods.

PROBLEM: Knowledge regarding the nutritive value, safety, acceptance and proper handling of tropical foods is incomplete or lacking. The best sanitary practices are seldom employed and many consumers are not well informed regarding quality and value of their food supply. There is also inadequate communication between the plant and animal breeder capable of modifying food attributes and the food technologist capable of measuring and maintaining these characteristics.

OBJECTIVES:

1. To develop comprehensive information on the nutritive value, safety and acceptance of present and potential tropical food materials.

2. To train food handlers in proper methods of handling processed foods and impart to them an appreciation of the deleterious effect of abusive treatment upon quality and safety.

APPROACHES:

1. Survey known food composition data and identify problems and hazards with specific crops.

2. Establish and maintain liaison with plant and animal breeders and assist them in improving the acceptance of new introductions.

3. Develop and adopt necessary analytical methods for nutritive value, toxicology and quality.

NEEDS/APPLICATIONS: Nutritional quality and safety of major food staples and new genetic material must be defined. Reasonable guidelines and methods of assessment should be available to breeders and industrial interests capable of commercial development of processing foods.

TOTAL INPUTS: 3 SMY's annually, 1 for each project.

WORKGROUP ON FLORIST AND NURSERY CROPS

Francisco Jordan
Paul Soderholm
Francis J. Marousky
Charles A. Conover, Reporter

TITLE: Production and shipping factors influencing market quality of tropical florist and nursery crops.

PROBLEM SITUATION: A serious loss in quality often occurs during shipping of tropical florist and nursery crops. Typical deterioration of foliage plants include leaf abscission, desiccation, leaf curl, chlorosis and physical damage from improper packaging. In cut flowers, major losses in quality occur from wilting (moisture loss), ethylene toxicity (sleepiness) and from physical damage. It is estimated that control of this problem could increase sales by several million dollars yearly and spur future development of the industry.

RESEARCH OBJECTIVES: Delineate the factors responsible for deterioration of tropical florist and nursery crops during shipping, and develop methods and/or systems to eliminate or reduce plant damage.

SUGGESTED RESEARCH APPROACHES: The basic influences of light, temperature, relative humidity, atmospheric pollutants and ethylene will be determined during production and shipping on representative tropical flower and foliage species. The possibility of interactions occurring among the described factors will also be studied. We estimate that it will require two or three scientific man years to complete this work within five years. This would require the aid of an ornamental horticulturist, post harvest physiologist and a plant pathologist.

REGIONAL NEEDS AND/OR APPLICATIONS: This research would meet the needs of tropical plant producers and shippers throughout the world.

PROMISING FUTURE POSSIBILITIES:

1. Search for new germplasm of tropical foliage and flowering plants and utilize these as well as available meterial in breeding programs.

2. Determine the potential for production and marketing of native tropical cut flowers and greens.

3. Investigate the potential for development of tropical bulbs as an export crops.

WORKGROUP ON SOCIAL IMPACTS OF TECHNOLOGY DEVELOPMENT

Fernando del Rio, Reporter

TITLE: Study of the Impact of the Research Program of the Experiment Station (and/or) University

PROBLEM SITUATION: Who is making use of the research findings in terms of the economic, education and social levels of the farmers?

OBJECTIVE: Determine the characteristics of the consumers or users of specific research findings of the research institutions.

SUGGESTED RESEARCH APPROACH:

1. Make inventory of research results in a specified period of time and select some of them, on a random basis or on purposeful basis, for the study.

2. Submit these research findings to a sample of farmers; record the characteristics of them and the reasons for the adoption or rejection of the findings.

TITLE: Study of research needs of the small farmer and of the subsistence farmer in order to provide an acceptable level of living for the farm family.

PROBLEM SITUATION: There is lack of information on the research needs of the above-mentioned groups required to improve their present levels of living.

RESEARCH OBJECTIVE:

1. Determine the level of improvement in specified enterprises needed to provide enough incomes for an adequate level of living of the above-described farmers.

2. Plan a research program for each enterprise in order to meet the above-stated requirement.

RESEARCH APPROACH:

1. Compile information on the levels of living of farmers and on their standard of living.

2. Figure out the minimum norms of increase in productivity of various enterprises to provide an acceptable level of living for the small farmer and the subsistence farmer.

TITLE: Evaluation of the communication processes used by Experiment Stations and Universities in order to inform the results of research to the public.

PROBLEM SITUATION: The time which elapses between the period in which the results of research are available and the point when they reach the people who can make best use of them, is considered too broad in order to make a significant impact on the farmers. Sometimes these results are superseded by new findings which make obsolete the previous ones, and the process repeats itself.

OBJECTIVE: Determine the communication process that is being utilized by the Experiment Stations and Universities in order to inform the results of research to the people and the time that is required for these results to reach the people and apply such technology.

APPROACH:

1. Identify a specified number of results of research from the Experiment Station in relation to:

   a. Date that the result was available.

   b. Date and channel by which the result was informed to specified public.

2. Select a number of farmers and determine their knowledge and the adoption of the technological result.

3. On this basis decide which of the communication channels, on combination of these, was most effective:

   Technical bulletins
   Newsletters
   Enterprise meeting
   Demonstration farms
   Manuals
   Bulletins
   Educational

TITLE: Social and cultural factors associated with the acceptance or rejection of specific research findings.

PROBLEM SITUATION: The possible lack of knowledge by the investigator of the natural science of the social and cultural factors associated with specific enterprises might lead him to engage in research that eventually will be rejected by the public to which it is intended.

OBJECTIVE: For selected research programs conducted by the Experiment Station and the University, determine the most crucial factors expected to influence the acceptance or rejection of the results.

RESEARCH APPROACH: Through bibliographical research or consultation with social psychologists, sociologists, or anthropologists or with other knowledgeable persons prepare a list of the forces which will influence people to accept or reject the predictable results of a particular piece of research. Anticipate ways and means of how to cope with the negative or positive forces: motivation (prestige, money, family advance); efficiency and others; sensorial factors such as taste, smell and appearance; psychological limitations due to the complexity or newness of the change involved; cultural factors such as traditions, systems of beliefs, customs, attitudes, social organization; leadership structure.

TITLE: Factors influencing the transferability of technology from one region to the other (or from one country to the other)

PROBLEM SITUATION: Transferability of technological results to new areas (or countries) is of great importance in order to advance progress in developing areas or countries. Adaptive research (or action research) calls for knowledge of fundamental factors associated with agronomical, ecological, climatic, sociological and political and institutional conditions.

OBJECTIVE: For selected technological results produced by the Experiment Station and University, determine the factors which might assure, to a reasonable degree, the transferability of such results to new areas or countries.

RESEARCH APPROACH: On the basis of the economic, sociological and agronomical conditions on which certain research was made, determine similar areas to which the results could be applied.

TITLE: Inventory of researcher's needs in developing countries - quantitatively and qualitatively.

PROBLEM: No reliable information is available on researcher's needs in developing countries, both qualitatively and quantitatively.

OBJECTIVE: Prepare a list of researchers in Latin America and determine their research needs both quantitatively and qualitatively.

APPROACH: Use appropriate survey techniques.

TITLE: Evaluation of Institutions serving the Agricultural Sector.

PROBLEM: The effectiveness of institutions other than research such as credit, marketing, extension in agricultural development has not been definitely established.

OBJECTIVE: Determine the effectiveness of various institutions serving agriculture.

RESEARCH APPROACH: Prepare an appropriate mechanism for estimating the effectiveness of selected institutions.